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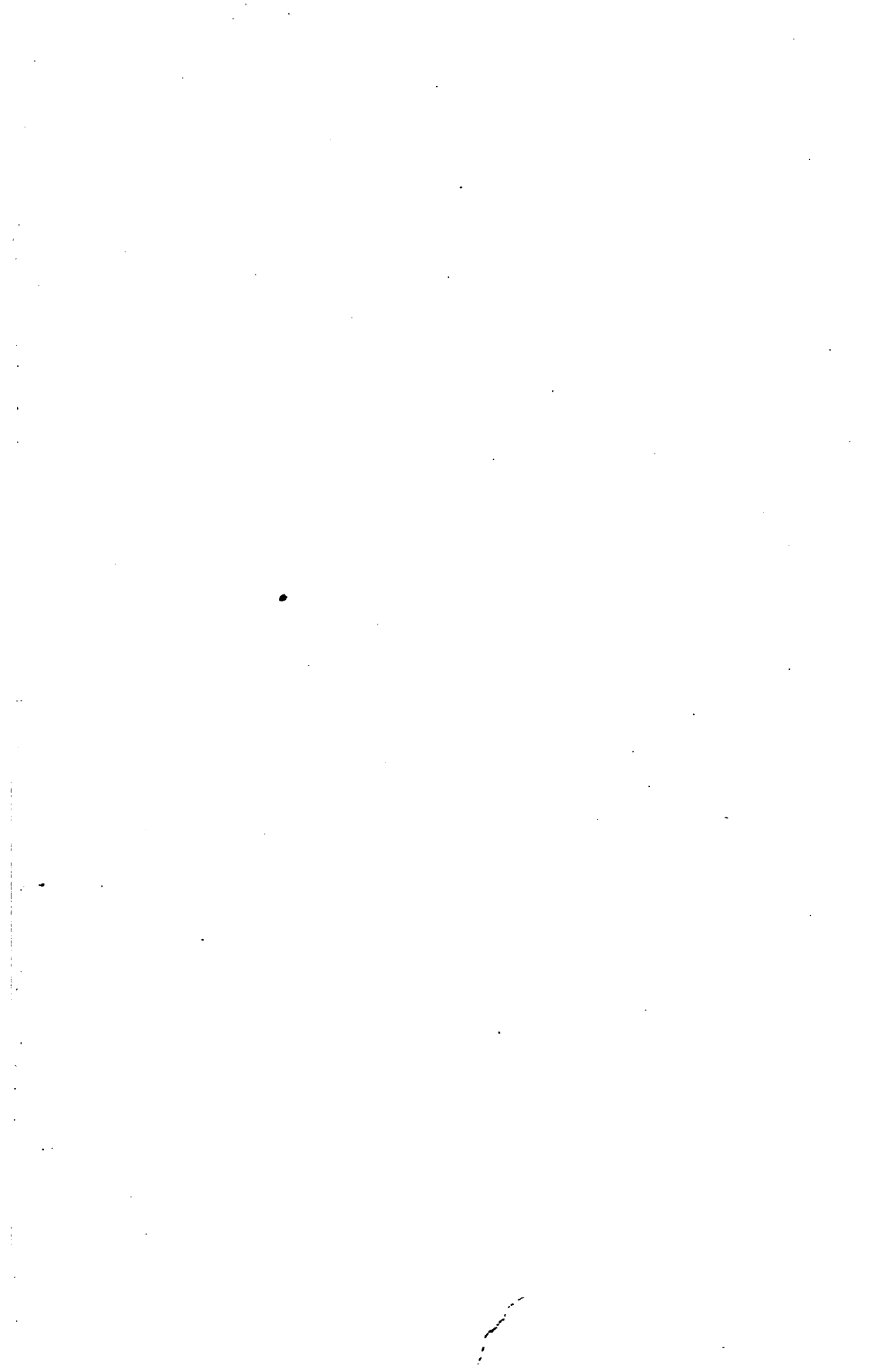
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PROGRESSIVE MEDICINE

A QUARTERLY DIGEST OF ADVANCES, DISCOVERIES
AND IMPROVEMENTS

IN THE

MEDICAL AND SURGICAL SCIENCES

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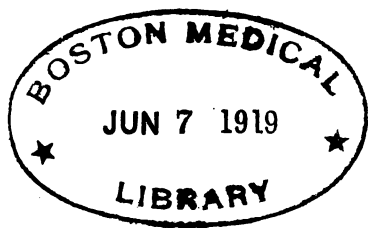
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VOLUME II. JUNE, 1919

HERNIA—SURGERY OF THE ABDOMEN, EXCLUSIVE OF HERNIA—GYNECOLOGY—
DISORDERS OF NUTRITION AND METABOLISM; DISEASES OF
THE GLANDS OF INTERNAL SECRETION; DISEASES OF
THE BLOOD AND SPLEEN—OPHTHALMOLOGY



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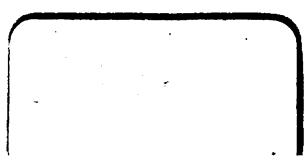
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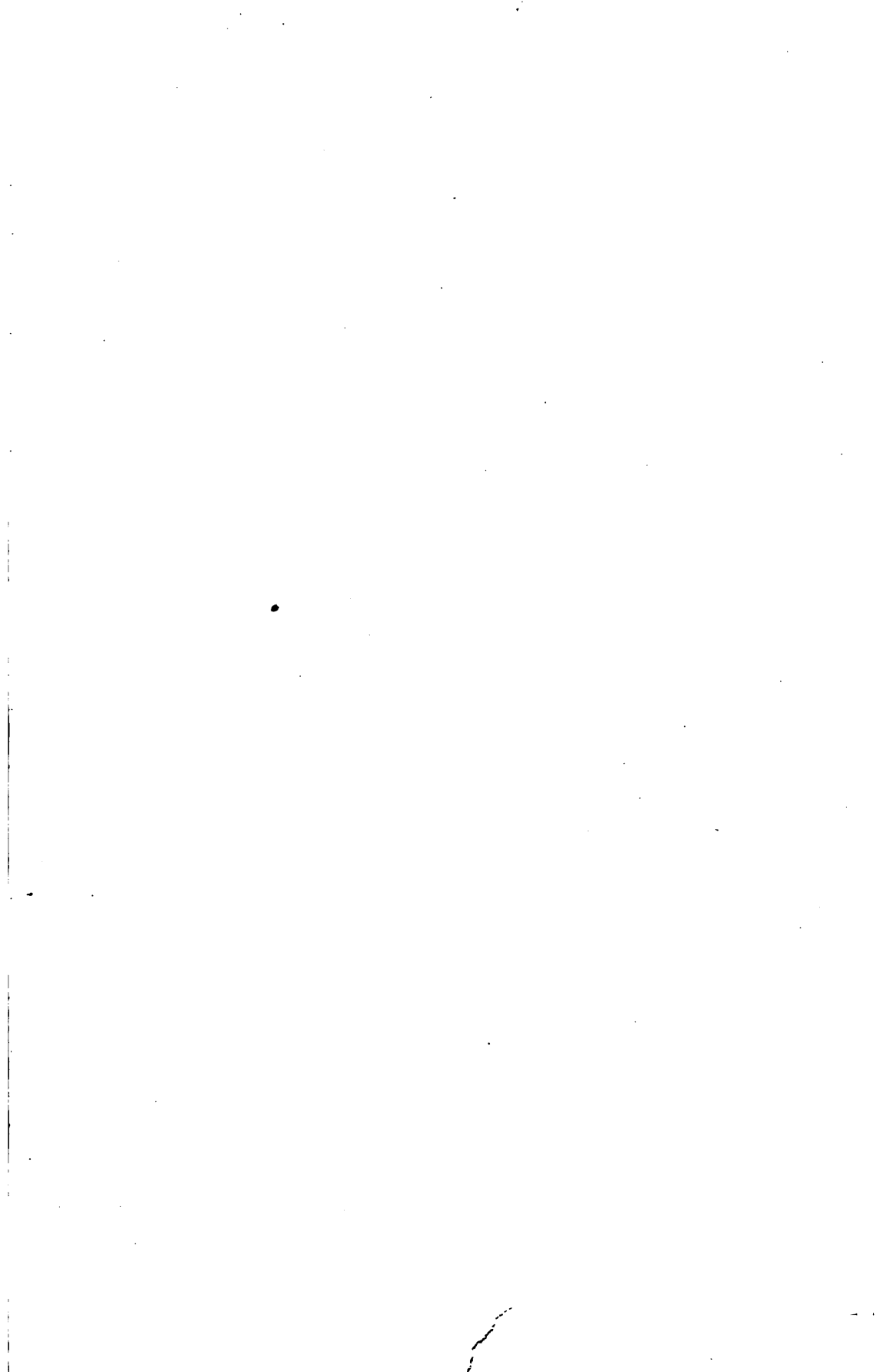
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of a continuous suture of fine kangaroo tendon, leaving just sufficient space at the lower end for a new external ring through which the cord emerges.

"The operation for inguinal hernia in the female is precisely the same as the operation we have just described, except that the round ligament is preserved and not transplanted.

"Femoral Hernia. The method employed in practically all cases of femoral hernia has been the simple, so-called purse-string, operation, consisting of first a very thorough removal of all the overlying fat which, in many cases of femoral hernia, completely surrounds the sac and makes it somewhat difficult to find the latter. Second, a very thorough freeing of the sac, pulling it down so that it is possible to place the ligature well beyond the neck, and, finally, the closure of the femoral canal by means of a purse-string suture of kangaroo tendon. Using a curved Hagedorn needle the suture is placed as follows: The needle is first passed through the inner portion of the roof of the canal, then downward, taking firm hold of the pectineal fascia and muscle, then outward through the fascia lata overlying the femoral vein, and finally upward, emerging through the roof of the canal about one-quarter inch distant from the point of entrance. When this suture is tied the floor and the roof of the canal come into easy apposition and the femoral opening is completely obliterated."

Umbilical Hernia. In umbilical hernia the Mayo operation is strongly advocated by these authors and the results observed at the Hospital for Ruptured and Crippled confirm their opinion that the Mayo method of overlapping is the best operation being used at the present time for the cure of large umbilical herniæ.

Undescended Testes. These statistics contain an unusually large number of herniæ associated with undescended testes, a total of 441, in nearly all of which the hernia was a potential one rather than an actual hernia, being merely an open process of peritoneum, communicating with the abdominal cavity and tunica vaginalis. The lower end of the sac in all of these sacs was sutured over the testis, making a complete tunica vaginalis. Another step is the removal of the fascial bands which surround the veins, after which it is usually possible to bring the testicle into the scrotum. In this series of cases the cord was never transplanted but allowed to drop back in the lower angle of the wound, the internal oblique being sutured to Poupart's ligament exactly as in inguinal hernia in the female. In none of these cases was there a recurrence of the hernia following the operation, and none proved fatal.

Direct Hernia. In the article by Hoguet and myself, we emphasize the importance of always transplanting the cord in these cases, and also in most of the cases of direct hernia they believe it wise to make use of some of the various modifications of technic in which the rectus muscle and fascia are used to strengthen the floor of the canal. We are of the opinion that the method described by William A. Downes² is perhaps the best of these methods. This has already been given in some detail in previous

² Annals of Surgery, 1911, liii, 568.

numbers of PROGRESSIVE MEDICINE. However, in spite of the best technic, they believe that direct hernia offers a much more unfavorable prognosis after operation than indirect hernia and that if all of the cases of direct hernia could be traced for a period of at least two years after operation they would show a relapse of 10 to 15 per cent.

SUTURE MATERIAL. With the exception of two or three cases operated upon in 1890, in which silk was used for buried sutures (and in which sinuses afterward developed), the absorbable sutures have been used in all operations for hernia at the Hospital for Ruptured and Crippled. I have, in previous numbers of PROGRESSIVE MEDICINE, frequently pointed out the disadvantages of their use, so that it will be unnecessary to further dwell upon the subject. Hoguet's and my statistics certainly prove that it is possible to obtain excellent results in the operative treatment of hernia by the use of absorbable sutures.

METHODS OF OPERATION. The typical Bassini operation, or the Bassini with slight modifications which have been described, was performed in inguinal hernia.

	Cases.	Recurrences.	Per cent.
<i>Inguinal Hernia—</i>			
Bassini	3725	14	.38
Cord not transplanted	792	11	1.3
Direct inguinal hernia, Bassini	24	0	.0

NOTE.—It should be stated that these cases of direct hernia all occurred in adult females and in children under the age of fourteen years.

	Cases.	Recurrences.	Per cent.
Transplanting rectus	8	0	.0
<i>Femoral Hernia—</i>			
Femoral, children	69	0	.0
Femoral, adults	182	8	3.1

NOTE.—It should be noted that four of the recurrences were in operations for recurrence.

The purse-string suture with kangaroo tendon was used in nearly all the cases, after a very high ligation of the sac and the removal of all the overlying fat.

	Cases.	Recurrences.	Per cent.
<i>Umbilical Hernia—</i>			
Umbilical hernia, vertical overlapping	34	2	5.8
Umbilical hernia, transverse or overlapping	77	1	1.8

A study of the time of the recurrence, *i. e.*, the interval between operation and the time that the recurrent hernia was noted, is of very great interest and importance. In 4453 cases of inguinal hernia in the male, 25 recurrences were observed, and of these 13 occurred within six months to one year after operation, three within one to two years. The other cases recurred at longer periods after operation: 1 after three and a half years; 2 after seven years, 2 after three years; 1 after four years; 1 after fourteen years and 1 after twenty years.

Mortality. The mortality has changed very little since the earlier statistics. From December, 1890, to January, 1901, a period of ten years, 2732 cases were operated upon at the Hospital for Ruptured and

Crippled, with six deaths, or 0.22 per cent. From January, 1901, to January, 1918, 3358 were operated upon with five deaths, or 0.15 per cent. The later deaths referred for the most part to cases of large irreducible or strangulated umbilical hernia.

End-results. With regard to the end-results of the first period, we find 15 recurrences in 2029 cases of inguinal hernia in the male, or 0.73 per cent. in the cases operated upon by the Bassini method, and 42.8 per cent. in the small group of cases operated upon by Czerny's method.

In the second period, from 1901 to 1918, covering 223 cases, there were only 10 relapses, or 0.45 per cent

CASES OF INGUINAL HERNIA OBSERVED AT THE HOSPITAL FOR RUPTURED AND CRIPPLED.

	Age.									
	Under 1 yr.	1-4	5-9	10-14	15-19	20-29	30-39	40-49	50-59	60
Male	4	790	1929	833	34	18	28	7	7	3
Female . . . . .	..	86	322	150	60	84	86	47	18	18

In this series, so far as it has been possible to trace, 1667 cases have remained well from one to four years, 586 cases have remained well from five to nine years, 193 cases have remained well from ten to fourteen years, 46 cases have remained well from fifteen to nineteen years, and 14 cases have remained well from twenty to twenty-six years.

Of 216 cases of femoral hernia, 169 have occurred in adults and 47 in children under the age of fourteen years. Ninety-nine cases have been traced in which the patients have remained well from one to twenty-four years after the operation, and in the entire series 8 recurrences are known to have taken place.

Of 166 cases of umbilical hernia, 118 occurred in adults and 48 in children; of the latter, 21 occurred in males and 27 in females. In 66 cases the patients are known to have been in good condition from one to eleven years after the operation, and in 25 cases for more than three years. Nine recurrences have taken place and 5 deaths—among the deaths was one case, a female, aged forty-four years, in which an extensive operation for carcinoma of the ovary was performed in addition to the hernia operation, and the patient died four days later.

Of 103 cases of ventral hernia, 86 occurred in adults and 17 in children. In this series 41 have remained well from one to fifteen years, the remainder not having been traced, and 11 recurrences have taken place.

Of 15 cases of epigastric hernia, 12 have occurred in children under the age of fourteen years, and the remainder in adults. Six cases are known to have been well from one to seven years after the operation, and in two cases a recurrence took place.

DIRECT INGUINAL. There have been observed at the Hospital for Ruptured and Crippled 54 cases of direct hernia, including 4 doubles, making a total of 58 cases of direct hernia. Of these, 37 cases occurred in adults (21 in females and 16 in males) and the remainder in children

under the age of fourteen years. As regards the sex in the latter, all occurred in males with one exception. These figures, however, do not represent the actual relative proportion occurring in the two sexes. It is only the last year that adult males have been admitted to the Hospital for Ruptured and Crippled. Direct hernia in the female is extremely rare and the relative proportion is more accurately shown in our statistics elsewhere. The final results in this list of 58 cases is of interest. In only one case is a recurrence known to have taken place. This case was complicated with a separate interstitial sac coming out of the internal oblique external to the internal ring and not connected with the round ligament; a recurrence took place seven months after the operation. Of the cases that have been traced, 18 have remained well from one to eight years.

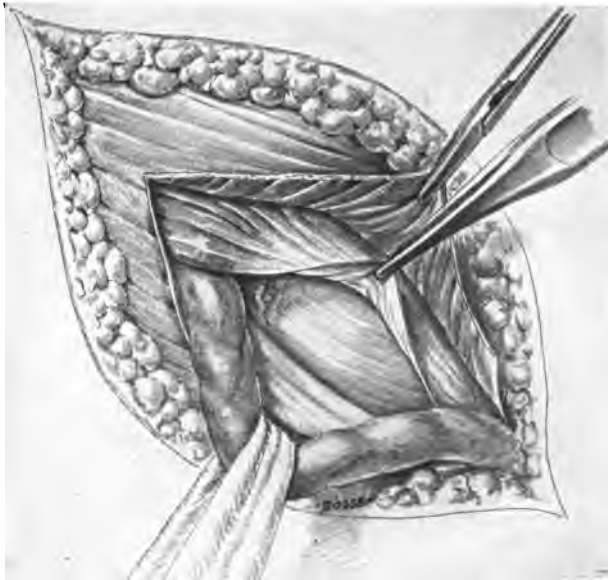


FIG. 1.—External oblique aponeurosis divided. Internal oblique muscle and aponeurosis retracted.

Rectus Muscle Transposition in Certain Cases of Inguinal Hernia. Schley,³ of New York, describes an excellent method of treating direct inguinal hernia. In the *Annals of Surgery* for October, 1913, Schley described the various methods of fortifying the weak area of Hesselbach's triangle, which is practically always found in the direct type of hernia. The article contains some excellent cuts, which show clearly the technic of the operation.

"Retraction upward of the oblique muscle and aponeurosis exposes the rectus covering. Incising this for three and a half inches behind the oblique aponeurosis and down to the pubes allows the rectus to be

³ *Annals of Surgery*, April, 1918, p. 465.

brought out without tension after the finger frees the muscle from its light attachment to the sheath. Four kangaroo sutures of medium size

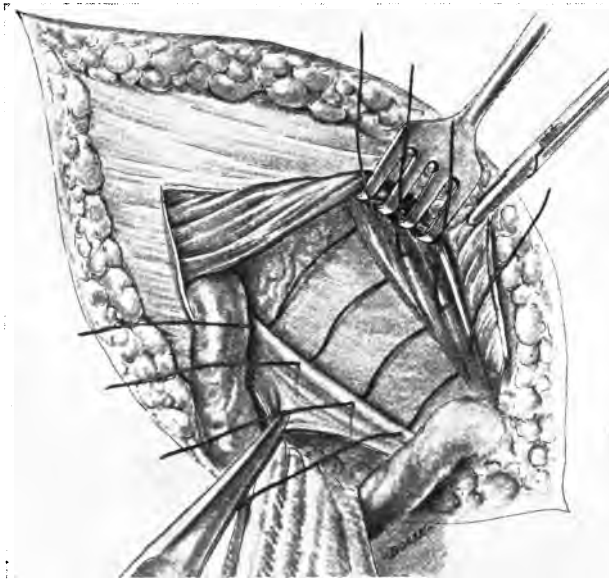


FIG. 2.—Rectus sheath opened, and, muscle having been freed, sutures are taken through muscle.

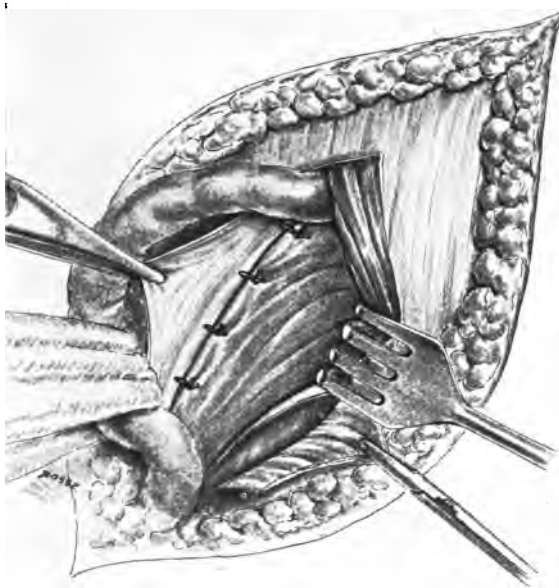


FIG. 3.—Rectus drawn to Poupart's (lower stitch should be taken nearer pubes, leaving no opening whatever).

attach it to the lowermost shelving portion of Poupart's ligament. The cord is transplanted as usual, and the internal oblique and its aponeurosis

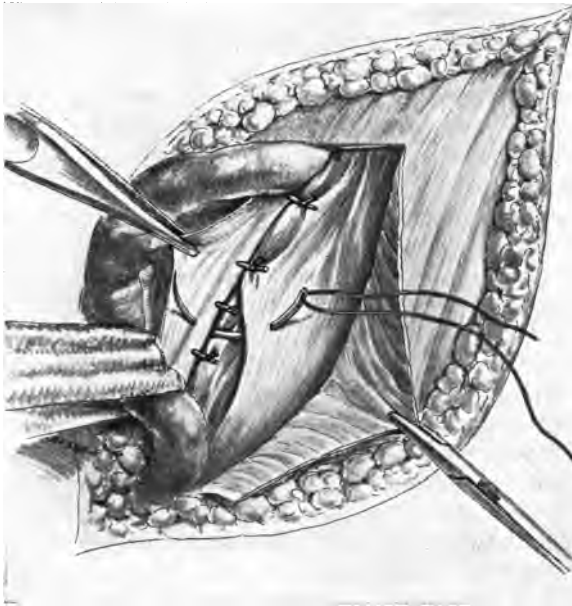


FIG. 4.—Internal oblique muscle and aponeurosis sutured well down to Poupart's over the rectus.

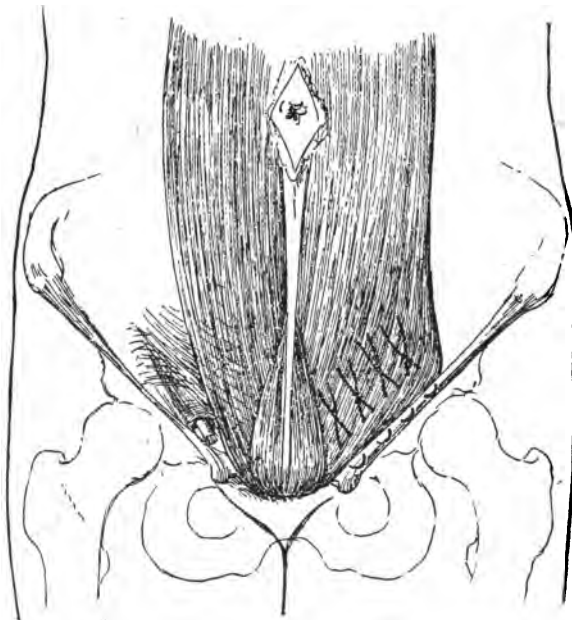


FIG. 5.—Deviation of fibers of rectus. (After Bloodgood.)

sutured down over the rectus following the routine method. The external oblique aponeurosis is closed, edge to edge, or overlapped, depending upon its normal tension or redundancy." Schley emphasizes "the freer opening of the rectus sheath down to the pubes together with the separation of the muscle from its light attachments to the sheath as a very great aid and sometimes necessity for the apposition to Poupart's without tension. The deviation of the muscular fibers is but little in this way and four sutures distribute what tension there may be. The lowermost stitch should leave no opening between the rectus and Poupart's ligament. Postoperative it is to advantage to allow these patients two pillows under the head and shoulders and one under the knees whenever they lie on the back for the first few days. Adequate rest in bed for sixteen to eighteen days will, I feel sure, get them back to duty with safety a month sooner than a week less in bed, and diminish their convalescent and disability time by so much. The function of sutures should be to bring tissues into apposition for union without strangulation and not to take any mechanical strain which the tissues themselves are capable of doing when firmly united by first intention."

Schley states that while it has not been possible to trace over one-third of the cases, he has learned of no recurrence in over six years' experience with the method. He states that "the procedure utilizing the rectus muscle in hernial repair has a definite indication and field of usefulness in a certain number of cases when the operation is made to fit the condition and not the condition a typical operation, however good that may be."

I fully agree with Schley's opinion as to the importance of strengthening the canal by some method of utilizing the rectus muscle, and the technic he has outlined is, I believe, one of the best methods of accomplishing this result.

Inguinal Approach in the Cure of Femoral Hernia. Landry, of New Orleans, in a paper read before the Louisiana State Medical Society in April, 1918,⁴ again strongly advocates the inguinal approach in the cure of femoral hernia.

In previous issues of PROGRESSIVE MEDICINE I have frequently taken occasion to criticize papers advocating the inguinal method of operation for femoral hernia. I expressed strong disapproval of substituting a comparatively difficult and complicated operation for a simpler one, unless superior results could be shown from the more complicated technic. Up to the time of my criticism, no such results had been offered by the advocates of the inguinal method, nor does Landry, in his paper above mentioned, furnish any such results. Like most other advocates of the inguinal method for femoral hernia, he begins by calling attention to the very great number of methods that have been used or are being used in the treatment of femoral hernia, and assumes that this very number of methods furnishes proof that we have no reliable method for the cure of femoral hernia. He states that Tuffier, in 1896, found twenty-nine methods in use or advocated for the cure of femoral hernia, while in

⁴ New Orleans Medical and Surgical Journal, November, 1918, No. 5, lxxi.

1907, Moschowitz found over 70 methods and modifications. His conclusion, however, by no means follows from the premises. One might as well say that because a very large number of operative methods for the treatment of inguinal hernia have been or are being used, therefore Bassini's method is not a good or an ideal method, and that someone ought to originate a better one. Landry uses a statement of mine made in Keen's *Surgery*, that "up to 1890, the results of operation in femoral hernia showed about 30 per cent. of recurrences." He fails, however, to quote a statement that I have frequently made in nearly all my articles on hernia, that the results in femoral hernia, operated upon by the high ligation of the sac and closure of the canal with a purse-string kangaroo suture, are nearly as good as the results in inguinal hernia from the Bassini operation, and have as yet been unequalled by any other method of operation for femoral hernia, including the inguinal.

Landry gives a very interesting history of the development of the inguinal approach to femoral hernia. He states that Widenham-Maunsell, in 1871, advocated median laparotomy to reduce a femoral hernia when strangulated or incarcerated, and closure of the ring from within. This was also advocated by Annandale, in 1878, and Tait, in 1883, concluded that the radical cure of all herniæ, other than umbilical, should be done by abdominal section, including even strangulated hernia.

Landry states that the inguinal approach in femoral hernia was first advocated by Annandale who, in 1876, operated on a patient with an inguinal and femoral hernia on the same side. He opened the inguinal canal, reduced both herniæ, suturing Poupart's ligament to Cooper's ligament, then closed the inguinal hrenia.

Zuckerkindl, in 1883, on the basis of a research upon the cadaver, advocated the inguinal route in strangulated hernia. These contributions toward the radical cure of femoral hernia went practically unnoticed until 1892, when Ruggi published a complete technic for surgical intervention in femoral hernia by the inguinal route. The following year Parlavecchio offered a modification of Ruggi's method. Tuffier, in 1896, popularized the method in France; Gordon, of Dublin, in 1900, advocated the inguinal route, suturing the internal oblique and transversalis to Cooper's ligament. Guibe and Proust, in 1904, sutured the internal oblique and transversalis to Cooper's ligament after complete division of Gimbernat's ligament. The inguinal route of approach has further been advocated by Codivilla and Magni in Italy; in Germany and Austria by Lotheissen, Foderl, Reich and Frank; in England by Fagge and Gordon; In Roumania, by Bardescu; in France, after Tuffier-Berard, Vallas and Perrin at Lyon (inguinal method without closing crucial ring), Chaput, Lujarier and Demarest at Paris.

Dujarier reports 31 cases of femoral hernia operated upon by the inguinal route, without recurrence. He makes it a practice in all cases of inguinal hernia, after opening the sac, to examine the femoral ring with the finger. In two instances he found small herniæ that had escaped the clinical examination. Matas first used the inguinal method in New Orleans, in 1893.

Among the more recent advocates of this operation have been Moschcowitz,⁵ Seelig and Tuholske.⁶

Landry then gives a careful description of the technic of the method which he has employed in 8 cases operated upon since 1915 and which is practically the same as that described by Seelig and Tuholske in their earlier publication referred to above.

As has been the case with most writers on the subject, the paper is confined to a careful description of the history of the method and its technic, and no space is given to the results obtained. Landry gives no data whatever as to his results. It needs but a brief glance at the complicated technic of the operation, to appreciate that it is much more difficult than the simple operation which I have advocated. If the results were distinctly superior to the results obtained with the simpler method, then the objection I have raised would no longer hold good. The advantages of the operation, as claimed by Landry, are (1) a clear and distinct exposure of the anatomical field; (2) high ligation of the sac is assured; (3) secure closure of the femoral ring is accomplished; (4) the second or abdominal incision is not necessary when dealing with a strangulated hernia.

While my statement, quoted by Landry, that "up to 1890 the results of operation in femoral hernia showed about 30 per cent. of recurrences" is, I believe, true, it should be stated that shortly after 1890 greatly improved methods of dealing with femoral hernia as well as inguinal hernia were developed. The method advocated by me consists in high ligation of the sac; purse-string suture of the canal with kangaroo tendon, bringing the floor and roof of the canal into close apposition, and allowing sufficient space for the femoral vein to pass without pressure. The results have been as follows: At the Hospital for Ruptured and Crippled we have had 251 cases of femoral hernia since 1890. Of these, 69 cases were in children, without recurrence; in 182 cases in adults—most cases traced—there have been only 8 recurrences, and it is only fair to state that of these 8, 4 operations were performed for recurrence after a previous operation, done elsewhere. Excluding these 4 cases, which should properly be excluded, there would be 182 cases with four relapses.

Until the inguinal route can show results at least comparable with these, it seems to me unwise to substitute the inguinal approach for femoral hernia for the external or crural route.

While the operation was originally proposed by Maunsell as a method to reduce strangulated or incarcerated femoral hernia, I believe that it is just this type of cases of femoral hernia, in which the inguinal method is most objectionable and is attended with grave risks. In proof of this I will cite the following case which has recently come under my observation:

A woman, aged sixty years, with a strangulated femoral hernia, was admitted to the Mary McClellan Hospital, Cambridge, N. Y., on the fourth day of the strangulation. A tumor, the size of a large goose egg, occupied the femoral region, extending upward over the aponeurosis,

⁵ New York State Journal of Medicine, October, 1897, p. 396.

⁶ Surgery, Gynecology and Obstetrics, January, 1914.

covering the inguinal and pubic region. On opening the sac we found a loop of small intestine, six inches in length, almost black in color, and considerable dark fluid with partially decomposed clots of blood of very foul odor, probably due to prolonged taxis. The fluid and clots were removed and the intestine washed off with saline; then the femoral ring was opened, relieving the constriction. After the application of hot saline compresses to the intestine for about ten minutes a slight return of circulation in the bowel was noticed. The intestine had not entirely lost its glossy appearance. It was a most difficult question to decide whether to resect the bowel or return it to the abdomen, trusting that it would prove viable. Believing that her general condition was not sufficiently good to enable her to stand a resection, I decided to replace the intestine in the abdominal cavity. The patient made an excellent recovery and had a spontaneous movement of the bowel the next day. The operation was performed under novocaine anesthesia.

Suppose that in this case it had been decided to operate through the inguinal route. It would have been necessary to make an even larger incision through the femoral ring to permit of reduction of the loop, and in reducing the bowel some of the foul contents of the sac just described would necessarily have entered the abdominal cavity and greatly increased the chances of peritonitis.

As regards the question of a radical cure of the hernia, I am sure that any attempt to close the femoral canal from the inguinal route would have been less satisfactory than the closure that I was able to make by the external operation.

Ware,⁷ of New York, recognizing the difficulty of reducing incarcerated or strangulated and gangrenous intestine in femoral hernia by the inguinal route, suggests a new step in technic. He states that "when I failed to relieve the constriction from within I was obliged to resort to a free division of all overlying structures. Thus, by the stroke of the knife, Poupart's ligament was severed. This division of Poupart's ligament he considers an unwarranted sacrifice, which renders its reconstruction eventually by suture impossible and favors recurrence. To overcome this difficulty he proposes the division of the femoral constriction from within by means of a fine silk thread. "This thread," he states "can be passed by means of a Deschamp or any needle sufficiently blunted or by means of the eyelet of a fine silver probe. By gently whip-sawing the thread a very exact and partial division of the fibers of Poupart may be executed, which can never injure the intestine, and sometimes the slightest excursion of the thread will be sufficient to reestablish the circulation of the intestinal contents and render the reduction of the gut possible. The thread may even be used as a tractor during the reduction. Thereafter it is divided and withdrawn."

While Ware's silk-thread method above described may be better than severing Poupart's ligament by free division of all the overlying structures externally, I see no advantages over the ordinary procedure employed in the older method of operating through the femoral route.

⁷ Surgery, Gynecology and Obstetrics, November, 1918.

In this case the femoral ring is nicked from within outward, and only sufficient of the ligament cut to permit of satisfactory reduction of the bowel. Ware's method does not overcome the serious objections I have already raised in reducing the more or less contaminated contents of the sac into the abdominal cavity by the inguinal method.

Fecal Fistula Following Strangulated Hernia. Haggard⁸ gives an account of 5 cases operated upon for fecal fistula following strangulated hernia. He states that while practically all cases of strangulated hernia unrelieved by operation invariably terminate fatally from peritonitis or shock, a small proportion, generally estimated at about 5 per cent., recover. In rare cases recovery is due to the destruction of the sac and skin by an inflammatory process, resulting in a fecal fistula and artificial anus. The abscess afterward ulcerates through the hernial sac and skin, and the general peritoneum becomes protected by adhesions. Five such cases have come under Haggard's personal observation. Four occurred in women, and one in a young boy. Three were femoral and 2 were inguinal. The period preceding perforation was from ten days to two weeks. Two ruptured spontaneously and 3 were opened for the resulting abscess. All drained fecal matter. Two healed naturally after four or five weeks, two after freshening the margins of the opening and one required abdominal section with detachment of the intestinal loop from its entrapped position in the femoral ring and suture of the opening. All recovered. Haggard gives a detailed report of these 5 cases which is of great interest.

As regards the end-results: 1 case, a boy, aged six years, operated upon in 1913, has remained well up to the present time. Another case, a woman, aged forty-five years, was well and in good health three years later. While recovery took place in the other 3 cases, the period of observation was not mentioned.

Umbilical Hernia. TECHNICAL OF OPERATIONS FOR LARGE UMBILICAL HERNIA. Delatour⁹ describes the Condemin-Ransohoff technic of operations for large umbilical hernia in the adult. He states that in most of the text-books and articles relating to the radical cure of umbilical hernia, most attention is directed to the closure of the wound, rather than the measures which may be taken to shorten the operation and the duration of the anesthesia. Delatour states that he began in 1898 to operate upon these cases by attacking the contents of the sac from within, as follows: "An elliptical incision is carried around the tumor so as to remove as much skin as necessary or to surround any ulcerated area. As soon as the sac is reached, it is isolated down to the ring, completely exposing the fibrous structure and extending a couple of inches above, below and laterally. An incision is now made in the median line, an inch below the ring, and the peritoneal cavity opened; the finger is introduced and with the scissors the incision is carried completely about the ring, first on one side and then on the other, until the median line above is reached. When the division is completed, the entire hernial mass, including the sac, fibrous ring and contents, is lifted free from the abdominal cavity.

⁸ Annals of Surgery, September, 1918, p. 272.

⁹ Ibid., June, 1918.

The next step is to remove the contents from the sac. The omentum, which is usually adherent to the wall of the sac everywhere, can be ligated at the ring, without the necessity of dissecting it free from the sac. If a gangrenous intestine is found, it is incised *in situ* and an anastomosis made, in this way preventing the necessity of handling the gangrenous intestine. This technic, he states, was published in the *Brooklyn Medical Journal*, No. 12, vol. xv, as an original procedure, but later found to have been previously described by both Condemin and Ransohoff. We have already described Ransohoff's technic in a previous number of PROGRESSIVE MEDICINE.

Delatour points out the following advantages of the method over any other approach of the sac in umbilical hernia:

1. It is the simplest method of dealing with the contents of the sac.
2. If gangrenous bowel is present, it may be removed without handling.
3. Large masses of adherent omentum can be removed with the sac and thus save the time necessary to free the many adhesions.
4. If there are any ulcerated skin areas they are removed with the primary incision.
5. It shortens the first stage of the operative procedure and greatly reduces the mortality.

I entirely agree with Delatour as to the advantages of this method of dealing with irreducible umbilical hernia. They are so apparent that the method has probably been used with slight variations by a great many surgeons long before it was published by Condemin. We have used it, with slight modifications, at the Hospital for Ruptured and Crippled for a great many years.

A. Belcham Keyes,¹⁰ of Chicago, briefly summarizes what he calls the ESSENTIAL POINTS IN THE METHOD OF HERNIA OPERATION, with special reference to the treatment of men drafted for the army. The method he describes is practically the Bassini, although it varies somewhat in minor points of technic. He advises placing all the deep or first layer of sutures beneath the cord before tying any of them; then drawing them surgically tight at one time. This the writer believes to be entirely unnecessary. The plan adopted at the Hospital for Ruptured and Crippled is to tie each suture as soon as it is placed, beginning with the suture highest up, just as it passes through the internal oblique muscle on the inner and Poupart's on the outer side and just touches the lower edge of the cord when held vertical to the lower plane of the abdomen.

Another variation in technic is the overlapping of the external oblique instead of suturing the edges of the external oblique, as advocated by Bassini and carried out at the Hospital for Ruptured and Crippled. Unless there is a very lax aponeurosis the writer believes this "imbrication" step to be entirely unnecessary, oftentimes causing unnecessary pressure upon the cord.

Keyes advocates that a "hay band" silkworm drain should be placed between the deep superficial and external oblique fasciæ, to be removed

¹⁰ Surgery, Gynecology and Obstetrics, July, 1918, p. 85.

on the fourth day. I believe that any form of drain, except in large umbilical hernia in stout women, is entirely unnecessary. Furthermore, I never dress a wound until the seventh day.

With regard to sutures, Keyes advises using the chromicized, No. 3, or larger, catgut or kangaroo tendon. While I have always advocated the use of non-absorbable sutures, preferably kangaroo tendon (although chromicized gut is the next best material) I believe a word of caution should be given lest these sutures be of too large caliber. No. 3 catgut or kangaroo tendon is much too large. If we use too large sutures the stiff knots often remain unabsorbed for a considerable period and may give rise to sinus formation which occurs so frequently after the use of non-absorbable sutures. The medium size suture, No. 2, or smaller, will remain unabsorbed quite long enough for solid union to take place.

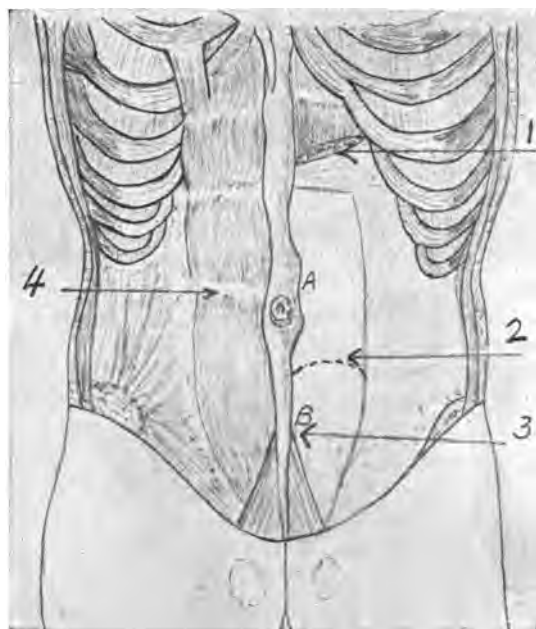


FIG. 6.—Between the points *A* and *B* the linea alba yields most to increased intra-abdominal pressure. 1, rectus abdominis cut across; 2, semilunar fold of Douglas; 3, point above pubis where linea alba is reinforced by the pyramidalis abdominis and triangular fascia. (MacLean.)

MacLean,¹¹ of Winnipeg, Canada, describes a new technic for the SURGICAL TREATMENT OF THE EXTREME PENDULOUS ABDOMEN, particularly ASSOCIATED WITH UMBILICAL HERNIA. The method is made clear by some excellent cuts which are here reproduced. He states that while at first sight the stretching of the structures appears to be universal to the whole anterior abdominal wall, it is entirely limited to a definite area in correspondence with a narrow line, the linea alba, and that point one and a half or two inches above the symphysis pubes. He very

¹¹ Surgery, Gynecology and Obstetrics, February, 1919, 190.

wisely states that surgical treatment should not be lightly undertaken and is called for only when the condition is causing troublesome symptoms. The operative mortality has been high in this type of patient; estimated by McGlannan at 6 per cent. for massive non-strangulated and 50 per cent. for massive strangulated herniæ. These figures are limited to cases of umbilical hernia and not to pendulous abdomen unaccompanied by hernia.

MacLean lays stress upon the preparation of the patient for operation. First in importance is rest in bed for a week to ten days in order to reduce to a minimum the intra-abdominal pressure and cleanse and render more nearly sterile the skin, which in nearly all of these cases is moist and foul from intertrigo. At the same time he recommends



FIG. 7.—Pendulous fat. Abdominal wall not relaxed. (MacLean.)

putting the patient on purgation and a very restricted diet, with daily warm baths and alcohol sponges, after which a folded sterile towel should be placed between the overhanging abdomen and the pubes to prevent the skin surfaces from coming in contact.

The steps of technic, according to MacLean, are as follows (Fig. 6): "Two long incisions forming an ellipse are made from one side of the abdomen to the other, the upper passing above the umbilicus, the lower passing about two inches above the fold where the abdomen hangs over the pubes. The skin and fat are dissected away from the external oblique aponeurosis until the ring of the umbilicus is met (Fig. 7). The abdomen is then opened at the umbilicus and the mass dissected away from the umbilical ring. Two lateral incisions are now made from the

umbilical ring to the inner margins of the recti muscles. A third incision is made from the umbilical ring downward to the firm lower margin of the internal ring; three flaps are thus formed, two lower and one upper.

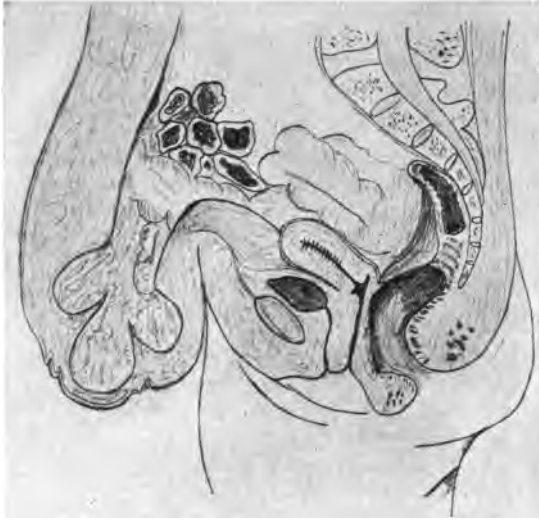


FIG. 8.—Extreme pendulous abdomen with umbilical hernia. The umbilicus forming the apex of the protrusion. (MacLean.)

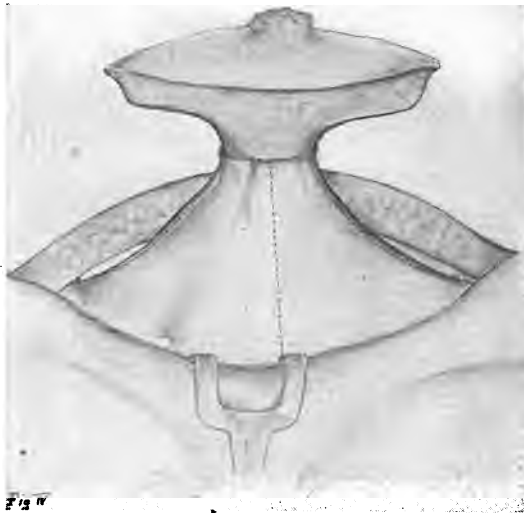


FIG. 9.—Elliptical incision. Fat dissected from external oblique aponeurosis, relaxed abdominal wall lifted up in form of a cone. (MacLean.)

The two lower flaps are overlapped from side to side, thus reducing by one-half the space between the recti muscles. The free margin of each flap is stitched with strong chromic catgut to the firm margin of the

sheath of the opposite rectus muscle. The upper flap is now drawn upward and the upper margin of this lower and now double flap is stitched to the upper margin of the so-called internal ring. The upper flap is next drawn downward and spread over the lower double flap and its margin stitched to the aponeurosis of the external oblique. The skin is closed, and three small tube drains are inserted, one at each angle and one in the center of the wound."

MacLean describes a series of 8 cases in which this method was used. I believe it to be of distinct value in selected cases. It combines the principles already demonstrated by Blake to be of great value in the treatment of umbilical hernia by vertical overlapping, and also that of Mayo's operation of transverse overlapping.



FIG. 10.—Congenital hernia of the diaphragm. (Downes.)

Diaphragmatic Hernia. William A. Downes,¹² in a paper read before the American Surgical Association in June, 1918, reports a case of CONGENITAL HERNIA OF THE DIAPHRAGM in a child, aged seven years. The history of vomiting immediately after taking food dated back five and a half years, or had its beginning when the child was a year and a half old. The periodic attacks of vomiting lasted from two to three months, with free intervals of about the same length of time. This continued until the child reached the age of about three and a half years, when vomiting ceased entirely for nine months. During the next two years there was great retardation in the development of the child. A year and a half before the operation the vomiting recurred and persisted, with short periods of remission of two or three days, up to the

¹² Surgery, Gynecology and Obstetrics, October, 1918, p. 393.

time of operation. There was no discomfort when eating, but a short time afterward he would vomit about one-half the amount of food that had been taken. When the child was one and a half years old he had a severe convulsive seizure, and at the age of two years he was dropped a flight of stairs—the vomiting attacks began at some time between these two incidents. An x-ray examination made by Le Wald showed the stomach to be above the diaphragm. A bismuth enema demonstrated the colon to be of normal size and location. X-ray diagnosis: Diaphragmatic hernia of the stomach. The operation, on January 4, 1918, consisted of an anterior gastro-enterostomy under intratracheal anesthesia. The liver was found to be nearer the median line than normal.

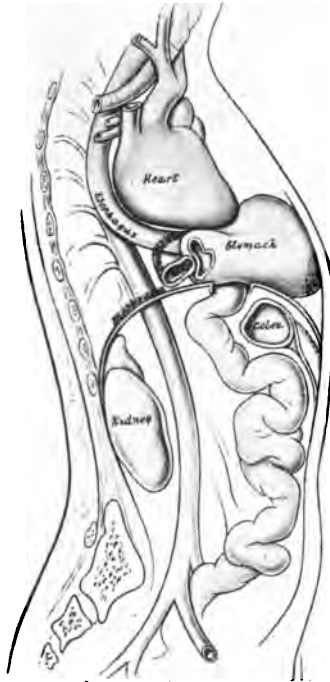


FIG. 11.—Diagrammatic sagittal section of congenital hernia of the diaphragm. (Downes.)

The duodenum was seen passing through the dilated esophageal opening, but no part of the stomach could be seen. A finger inserted through the dilated opening located the stomach entirely above, and resting upon, the diaphragm. Traction upon the duodenum failed to dislodge the pyloric end of the stomach. In view of the poor condition of the child it was deemed wiser not to attempt to restore the stomach to its normal position but to perform an anterior gastro-enterostomy through the dilated esophageal opening. This was done by drawing a portion of the greater curvature of the stomach partly into the abdomen, the jejunum being brought forward over the transverse colon, and the anastomosis made about sixteen inches from the duodenojejunal junction. The

patient made a good recovery and gained ten pounds in weight five months after the operation.

Downes's paper contains a careful review of the literature on the subject. He states that up until recently there have been few cases reported in which a correct diagnosis was made and operation successfully performed.

Up to 1912, Scudder was able to find only 6 recorded cases in which a diagnosis had been made prior to the operation, nearly all of the cases previous to that date having been operated upon for supposed intestinal obstruction, with a very high mortality.

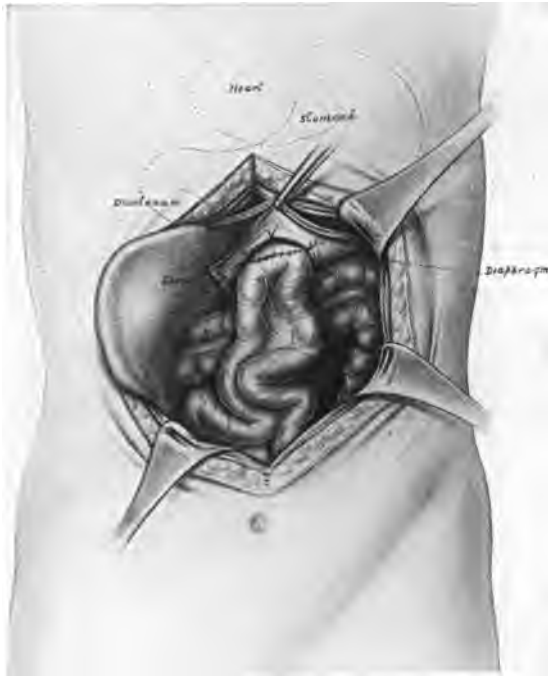


FIG. 12.—Anterior gastro-enterostomy through dilated esophageal opening in congenital hernia of the diaphragm. (Downes.)

Downes states that the congenital diaphragmatic herniæ are classified as true or false depending upon the presence or absence of the sac, the great majority of cases having no sac, the hernial contents passing directly through the diaphragm either through a dilated normal opening or through an abnormal opening and lying free in the pleural cavity. This variety is much more common on the left than on the right side, due to the presence of the liver on the right. The usual position of the hernial orifice is near the junction of the costal and lumbar portions of the diaphragm. The hernia very seldom passes through the normal opening in the diaphragm.

Of the 34 specimens collected by Keith, only one was found occupying the normal opening. In this case the hernia protruded through the

esophageal opening. In most of the cases of congenital diaphragmatic hernia, death occurred shortly after birth. The patients suffer from dyspnea, become cyanotic and usually die in convulsions.

With regard to the physical signs, Downes states these vary according to the number of abdominal organs in the thorax and according to the state of the viscera at the time of the examination. When filled with air, the condition has been mistaken for a pyopneumothorax and aspir-



FIG. 13.—Roentgenogram of N. C., six hours after second meal. Residue still present after twenty-four hours. (Downes.)

ated, with a fatal result. A warning should be given never to aspirate a patient with obscure unusual physical signs of the chest until an x-ray examination has been made. In cases of diaphragmatic hernia in which the diagnosis has been established by an x-ray examination, and in which the patients are suffering from no symptoms, it may be wiser not to operate. In the presence of acute symptoms in a known case, one should operate at once.

As to the method of operation, some advise operating through the thorax and closing the opening of the diaphragm from above. Downes believes that while this may be the method of choice in traumatic cases, its advantages are more than offset by the knowledge gained from an exploration of the abdominal cavity and the ability to relieve the condition without a prolonged operation. Not infrequently, when one operates by the thorax route, it has been found necessary to supplement the



FIG. 14.—Roentgenogram taken four months after operation, twenty minutes after meal. (Downes.)

operation by an abdominal incision in order to restore the viscera to their correct positions or for the purpose of closing wounds of the stomach or of the intestine. Downes believes that in the congenital cases in which the hernia has occurred through a dilated normal opening, such as the esophageal opening, it would be impossible to correct the condition by approach from above. In the majority of recorded cases, it has been possible to restore the organs to the abdominal cavity, and close the opening in the diaphragm. In a few instances where the opening was

too large to close satisfactorily, the stomach or omentum has been used to complete the closure. In a case similar to the one Downes reported personally, it was found impossible and unwise to attempt reduction. In this case he believes that gastro-enterostomy is the method of choice.



FIG. 15.—Congenital hernia of the diaphragm, six weeks after operation. (Downes.)

Inguinofemoral Hernia. Twyman, of Kansas City,¹³ reports a case of inguinofemoral hernia due to suppurative destruction of Poupart's ligament, in which he used the sartorius muscle for repair. The patient was a male, aged forty-one years, weight 220 pounds, who, at the age of twenty-four, had a severe illness which was regarded by physicians as appendicitis. A large abscess developed in the lower right abdominal region, which, at the end of six weeks, pointed in two places, in the right inguinal region and right Scarpa's triangle. Both regions were incised, with the result that two fistulæ discharging foul pus remained open for five months. Later on there developed a bulging in this region which gradually increased until at the time of the operation it had reached the

¹³ Surgery, Gynecology and Obstetrics, August, 1918.

size of a fetal head. The tumor was at first easily controlled with a truss, but later control became difficult and several attacks of partial strangula-

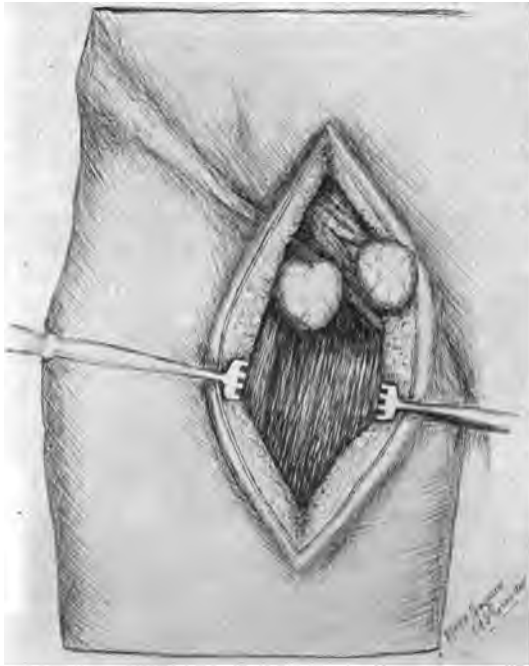


FIG. 16.—Multiple hernia. (Twyman.)

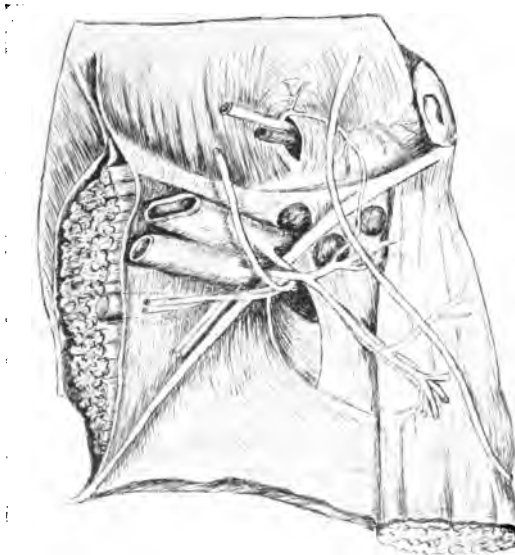


FIG. 17.—Normal anatomy (modified after Gray and Ferguson). (Twyman.)

tion or torsion occurred. The tumor occupied both the inguinal and femoral region, and Poupart's ligament was apparently absent. The case was operated upon by Twyman in 1913. He states that he "realized the possibility that there was first a direct protrusion through Hesselbach's triangle, and that, after having attained a certain size, the further giving way of the damaged tissues may have so increased the area of the protrusion as to allow the greater bulge on the outer side of the deep epigastric vessels, which then slipped or were crowded more and more to the inner side, finally assuming the position in which they were found. The cord crossed the sac into the scrotum. Another possibility was that both inguinal and crural sacs preëxisted, and that they were crowded into one as the sac grew larger. The femoral vessels were overlaid *in toto*."



FIG. 18.—Diagrammatic drawing showing altered anatomy in author's case. (Twyman.)

"No attempt was made to separate the tissues of the inner edge of the gap into their anatomical elements. But using the pressure-thickened strong edge, and taking large amounts of the tissues in each stitch, the inner edge was drawn down and sutured with kangaroo tendon and chromic gut to the following tissues from within outward: Cooper's ligament, periosteum of the ileopectineal line, scar tissue remains of Poupart's ligament and the beginnings of the fascia lata of femoral fascia. This resulted in more tension than was desirable, although the strength of the tissues looked promising for the result. However, the unsutured gap through which the femoral vessels emerged into the leg was an apparent and vexations source of weakness and a potential point of recurrence. A flap of the fascia lata with an attached proximal base was lifted and reflected over the stitch line and sewed in place. This

effectively covered the above-mentioned gap, but, as the fascia lata at that point in the thigh is not as thick and strong as in the outer aspects of the leg, I was still unwilling to trust even the reinforced line with the tension of so large a gap in so fat a subject. The sartorius was readily made available through the large opening in the skin without further enlargement. It was split into two rather unequal portions down to about the middle of the thigh and the larger inner portion was divided squarely across at its lower end and swung inward and attached to the fascia over the insertion of the right rectus muscle. To lessen the chance of recurrence, the testis was placed in the abdominal cavity in the retroperitoneal region. The author states that at the time of the last observation, two years later, there had been no recurrence.

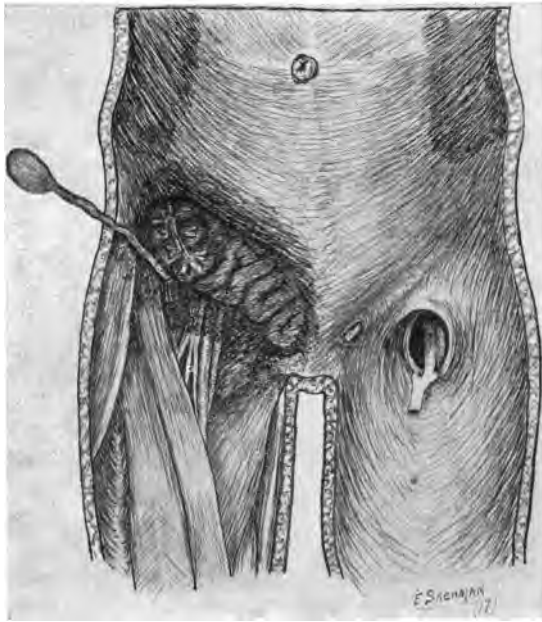


FIG. 19.—Same as Fig. 18. (Twyman.)

Twyman calls attention to the great rarity of inguinofemoral hernia and warns against confusing an inguinofemoral hernia with an inguinal and femoral hernia coexisting on the same side. The latter condition is not infrequent. He also refers to Holthouse's original monograph on "Hernial and Other Tumors of the Groin," London, 1870, a book which he was only able to obtain from the Surgeon-General's Office. The case of Holthouse, which he cites and which the latter characterizes as inguinocrural hernia, is really nothing more nor less than a typical case of the variety which has long been described as inguinoperforating hernia of the undescended or maldescended testis. The term inguinocrural is a misnomer, as the sac usually rests upon the outer surface of the oblique and rarely extends downward over the crural region. Holthouse states that

the chief interest attached to the inguinocrural variety of hernia lies in its resemblance to femoral hernia, and quotes Munro, who said, "There are many cases within my knowledge where this mistake was never discovered until after the operation was performed."

I cannot agree with Holthouse that the diagnosis is at all difficult, certainly not to anyone who has observed this condition. In the first place the scrotum will be found empty on the side of the hernia and the testis situated just under the skin and superficial fascia outside of the external ring. Careful examination will show that the femoral ring is entirely empty, and the swelling, which is usually reducible, will be found on reduction to pass into the canal through the external abdominal ring and not through the femoral. I therefore repeat that the term inguinocrural is a misnomer and should be abandoned. There is much more reason for using the term femero-inguinal to describe those comparatively rare cases in which a femoral hernia, after emerging from the femoral ring, passes upward and occupies the inguinal region. In some of the cases of this kind the hernia will be irreducible and the diagnosis by no means easy before operation, although careful examination will disclose the fact that the external inguinal ring is empty, thus making it certain that the hernia is of the femoral variety.

Personally, I believe that the cases in which it is necessary to use the sartorius muscle or any of the thigh muscles for the cure of femoral or inguinal hernia are extremely rare. The case which Twyman describes apparently is a valuable addition to the technic. Personally, I have never seen a case of hernia in which Poupart's ligament was destroyed by previous inflammatory troubles. I believe there is no good reason for placing the testis in the abdominal cavity in hernia operations. Although Twyman believes that no good ground for regarding the undescended testis is more liable to malignant degeneration than the normal testis, we believe this opinion is an error, as shown by our discussion elsewhere of the undescended testis.

Richardson, of Baltimore, in the *Annals of Surgery*, April, 1918, p. 471, reports an interesting case of SAPHENOUS VARIX SIMULATING A FEMORAL HERNIA, in a female, aged thirty-eight years, who was admitted to the gynecological department of the Johns Hopkins Hospital on March 4, 1917, for symptoms referable to her pelvic organs and a swelling in the right groin. She had previously undergone two operations: one four years ago for radical cure of a right femoral hernia and appendectomy, and in January, 1917, she was operated upon for a right oblique inguinal hernia. After both operations the reducible tumor for which she had been operated upon promptly reappeared in the right groin. The swelling was about the size of a hen's egg directly over the femoral canal; this disappeared on lying down. There was a definite impulse on standing or coughing. Richardson states that he made an incision directly over the tumor, but instead of directly exposing a hernia sac, he encountered in the subcutaneous tissues of the groin, just over the cribriform fascia and the femoral canal, a small circumscribed mass of fatty tissue containing a few lymphatic glands and a plexus of much dilated veins. The trunk veins were ligated and a mass of varices and

fatty tissue were excised. Richardson states that there were no varicose veins lower down the leg. He adds that he has collected reports of 10 cases of circumscribed saphenous varix in the region of the femoral canal and external abdominal ring, the earliest being by a French observer, Boinet, in 1836. Seven of these were diagnosed prior to operation either as incarcerated or strangulated femoral hernia.

This condition, though comparatively rare, has been observed many times at the Hospital for Ruptured and Crippled.

A correct diagnosis can always be made even by one who is not familiar with the condition, if the well-known points in the differential diagnosis are carefully observed. These I have discussed in some detail in my article on "Hernia" in Keen's *Surgery*, most of them also being emphasized by Richardson. In the first place, the tumor is almost always situated in the region of the femoral opening. The mass, which often reaches the size of an English walnut, or a small hen's egg, is usually soft or easily reducible but, unlike a hernia, immediately reappears even without the patient standing or coughing. The impulse on coughing is distinctly different from that of a hernia, it resembling more a thrill as fluid passing through a soft tube, rather than a solid body propelled against the fingers. Another important point in the differential diagnosis: If the patient is examined in an upright position and the tumor is pressed back with the fingers, it will immediately reappear on a slight relaxation of pressure, whereas a hernia would not reappear without complete relaxation. In nearly all the cases personally observed, there have been present, more or less marked varicose veins further down the leg, particularly below the knee. At the Hospital for Ruptured and Crippled the condition has always been recognized from the clinical symptoms and no cases have come to operation. Operation is seldom, if ever, indicated.

Perineal Hernia. Moschcowitz¹⁴ reports a very interesting case of perineal hernia, and gives an admirable review of the literature of the subject. He states that he has been able to find only 28 cases of perineal hernia reported in literature. In some of these 28 cases the history is so incomplete, that it is more than doubtful if they should be properly classed as perineal hernia. In 20 of the cases reported the diagnosis rests merely upon clinical observation; only 4 were operated upon and only 4 examined postmortem.

Moschcowitz's case occurred in a female child, aged two and a half years, and was operated upon on May 23, 1916. The mother had noticed a swelling in the right buttock six or seven weeks before; this had slowly increased in size during this period. Physical examination showed in the right buttock a moderately firm, very movable swelling occupying, roughly speaking, the region bounded mesially by the coccyx and anus, and laterally by the tuberosity of the ischium and the gluteus maximus. The palpable surface of the mass was globular and increased in size when the child cried. On manipulation, the mass escaped in an upward direction, but it never disappeared entirely. Rectal examination

¹⁴ *Surgery, Gynecology and Obstetrics*, May, 1918.

revealed a mass upon its right; when an attempt was made to reduce the mass, the palpating finger noted that the rectal fulness increased in volume. It was impossible to determine by examination whether the hernia, for such it was taken to be, was reduced through the sciatic notch, or through a hiatus in the levator ani.

On account of the possibility of the presence of a large subperitoneal lipoma, Moschcowitz chose the perineal route for operation. "With the patient in a prone position and with the buttocks elevated, an oblique incision three inches in length was carried over the tumor in the right buttock. On reaching the ischiorectal fossa, a long lipomatous mass was encountered, distinctly encapsulated, leading upward into the depth of the wound. At its basal attachment, it had to be separated from the underlying peritoneum by a sharp dissection. When this was finally accomplished a defect in the pelvic floor was found through which two fingers could be introduced into the abdomen as high as the pelvic brim. On increasing the intra-abdominal pressure, a hernial sac was seen to descend through this hiatus. This sac was not opened nor resected, however, as it was recognized to be too intimately adherent, posteriorly to the rectum, and anteriorly to the vagina (hernie par glissement). The opening in the depth of the pelvic floor was then closed by interrupted chromicized catgut sutures, and was reinforced by liberating the gluteus maximus and suturing its inferior margin to the deep pelvic fascia. The specimen removed proved to be a lipomatous mass, 6 x 2 inches in size. A small portion of the peritoneal sac was adherent at its deepest attachment, and was proved to be such on microscopic examination. The wound healed by primary union."

Moschcowitz states that in his own mind there was not the slightest doubt as to the correctness of the diagnosis of perineal hernia, yet he confesses that he has not brought forward such proof that the diagnosis may be said to be without any doubt. He believed that the hernia made its exit at the seat of predilection for these herniæ, *i. e.*, the posterior border levator ani, or, better said, through the very frequent cleft between the levator ani and the coccygeus, and that subsequently the hernia burrowed a way for itself into the ischiorectal fossa. A lipoma accompanying a hernia, he states, is not at all an infrequent occurrence in perineal hernia. Moschcowitz also gives a brief resumé of some of the more important cases from the literature.

Pudendal Hernia. Moschcowitz in the September, 1918, number of *American Journal of the Medical Sciences*, p. 394, reports a case of "pudendal hernia," and gives an interesting resumé of the literature on this rare type. He states that early in the nineteenth century Sir Astley Cooper first described this variety of hernia and gave it the name of "pudendal hernia." Moschcowitz believes this name is incorrect for the following reasons: (1) Because it does not sufficiently differentiate a pudendal hernia from the very common oblique inguinal herniæ of large dimensions, which also occupy the pudendum; (2) because, contrary to our usual custom, the name is derived from the ultimate resting place of hernia and not from the point of its escape out of the abdomen. Moschcowitz would prefer the name of "subpubic hernia," a name first

proposed by von Winckel, and one which describes the point of exit from the abdomen. As "pudendal hernia" has been the name universally adopted in describing this rare type, Moschcowitz recognizes the difficulty in changing its nomenclature.

Moschcowitz's patient was a woman, aged forty-one years, who was first observed by him in May, 1913. The hernia was noticed shortly after a forceps delivery, in November, 1895. Soon after the delivery a mass appeared protruding from the vagina, and coincidentally with it an incontinence of the bladder was also noted. She was operated upon for this condition in December, 1895, by Dr. F. Lange, formerly of this city, who attempted to close the defect of the bladder, and to form a new urethra out of the left labia minus. A second operation was performed in May, 1896, and a third in January, 1897, at which time an attempt was made to suture the fractured end of the pubic bone by means of silver wire. The wound became infected and had to be reopened. Intractable sinuses formed throughout the length of the incision until the silver sutures were removed about six months later, at the same time another unsuccessful operation (the fourth) was performed in an attempt to cure the hernia by a vaginal operation. A fifth unsuccessful attempt was made in June, 1899. In 1908, the patient was again pregnant and was delivered prematurely by a breech presentation. After this confinement the hernia rapidly increased in size, making the patient a complete bed-ridden invalid.

All further operations were discontinued until March, 1913, when Dr. Robert Abbe, for the first time, attempted to cure the hernia by the abdominal route. A recurrence shortly after took place, and on May 15, 1913, the patient came under the care of Moschcowitz.

The operation performed by Moschcowitz on May 27, 1913, was as follows: "Median laparotomy extending from the symphysis pubis to one inch above the umbilicus. Massive adhesions were encountered at the site of the last operation. After liberating the adhesions, it was seen that the hernia was of the sliding variety, involving the left half of the bladder. The small intestines were adherent in the depth of the sac and were freed. The hernial ring was a large, irregular oval, easily admitting the folded hand and was bounded externally by the ascending ramus of the pubis and mesially by the soft tissues of the bladder, uterus and vagina. Neither the pelvic fascia nor levator ani were available, both having been destroyed by the original forceps delivery. After incising the pelvic peritoneum anterior to the left broad ligament, the uterus was dislocated into an extreme sinistroversion and fastened in its new position with a number of Pagenstecher sutures to the descending ramus of the pubis. The duration of the operation was two hours. The convalescence was exceedingly stormy." The patient remained comfortable for a short time, but one year later the uterus returned to its normal vertical position, and there was again a hernial bulging. She was last heard from a year ago, at which time the hernia had recurred to its former dimensions.

With regard to the treatment of the condition, Moschcowitz states that there is no case of pudendal hernia on record as having been cured,

and only two, besides his own, have been operated upon, both by von Winckel. Moschcowitz adds, "Attempts by means of vaginal or labial plastics must be followed by failures, as no opportunity is given to follow up the two cardinal principles underlying the radical cure of every hernia, namely, high ligation of the sac and a closure of the internal hernial ring." In spite of the difficulties which may be encountered, Moschcowitz believes this can best be attained by approaching the seat of the trouble by the abdominal route.

Suprapubic Hernia. A case of suprapubic hernia, an extremely rare type, was reported by Forshaw, of England, in the *Lancet*, June 30, 1917, p. 998. Forshaw stated that he knew of only one other case, described by Voeckler.¹⁵

Forshaw's patient was a woman, aged forty-one years, who, on the day before admission to the London Hospital, while in the act of micturition, suddenly felt a sharp pain just above the symphysis pubis, after which she found a swelling which had never been noticed before. The latter was accompanied by intense pain and vomiting every half hour. She was admitted to the hospital twenty-four hours later. Physical examination showed a smooth, hard, rounded swelling about the size of a double forefinger situated just above the symphysis pubis in front of the right rectus muscle, which was tender on pressure and gave no impulse on coughing. On operation, there was found a strangulated hernia emerging from the abdominal cavity between the two recti muscles very near to their insertions. The sac was firmly nipped at the neck; constriction was divided, the gut was returned and the sac cut away. The patient made a good recovery.

Strangulated Direct Inguinal Hernia. In the *British Medical Journal*, March 2, 1918, p. 258, Rayner, of Manchester, England, described a case of reduction *en masse* of a strangulated direct inguinal hernia. The case is of great interest because of the fact that strangulation *en masse* is exceedingly rare, and furthermore because in this case it was a direct inguinal hernia. Personally, I have never seen a strangulated direct hernia and believe that few have been reported in the literature. It is also worthy of note that it occurred in a woman, direct hernia in a female being extremely rare.

The patient gave a history of three days previously having felt sudden pain in the abdomen and right groin. A few minutes later she began to vomit and then for the first time noticed a lump in the right groin. The patient had no previous history of hernia. Her attending physician, Dr. Taggart, who saw her two hours after the onset, found a tense, rounded swelling in the right inguinal canal, about the size of a tangerine orange, which did not yield an impulse on coughing. A diagnosis of strangulated hernia was made, and under gentle manipulation it was easily reduced. Taggart was struck by the fact that the reduction was sudden and complete, giving him an impression like that of pushing a button through a buttonhole. The patient felt relieved for a time but during the night and the next day she was uncomfortable and had

¹⁵ Lejars: *Urgent Surgery*, 1912, 2d ed., p. 228.

occasional attacks of slight colic, and vomited twice; the following day she still complained of great discomfort accompanied by vomiting and abdominal pains. Her condition, when seen by Rayner a few days later, was as follows: General condition good; temperature normal; pulse 92; abdomen slightly distended. There had been no movement of the bowels and no purgative medicine had been permitted during the time between the reduction of the hernia and last examination. A laparotomy was performed some hours later, revealing a loop of small intestine, four inches in length and about three feet above the ileocecal junction, tightly strangulated in a peritoneal pouch, which later proved to be a direct inguinal sac displaced from the inguinal canal into the abdominal cavity. By dividing the orifice of the sac, the loop of strangled intestine was easily released; at its point of entrance into the sac, the loop showed a narrow annular strip of gangrene which was covered over by an invaginating suture. The patient made a good recovery.

Rayner believes that the reason why the character of the symptoms of obstruction were not more severe was due to the deliberate abstention from any aperient medicine and the striction of the patient's nourishment to the plainest fluids.

Duodenojejunal Hernia. At the Chicago Surgical Society meeting, held March 2, 1917, Hallock¹⁶ presented a specimen of duodenojejunal hernia. No clinical history could be obtained and the hernia had nothing to do with the cause of death, the condition being discovered at autopsy.

Hallock states: "The pancreas and duodenum lie to the right of the orifice of the sac in their normal location. The inferior mesenteric vein is seen passing upward to the left of the orifice and then curving to the right above the orifice. It lies within the plica venosa. The orifice of the sac lies to the left of the ascending portion of the duodenum and below the plica venosa and inferior mesenteric vein. The orifice admits the tips of three fingers easily.

"Only one loop of bowel, the efferent loop, passes through the orifice. The efferent loop, which frequently happens in such hernia, has become fused with the structures of the posterior abdominal wall and enters the sac behind. The hernia is not reducible, due to adhesions within the sac. However, no signs of strangulation are present."

Femoral Hernia. In the *Lancet*, October 20, 1917, p. 606, Coulson, of Edinburgh, reports a case of strangulated femoral hernia in a woman fifty years of age. On operation the cecum was found to be nearly black in color but shiny in appearance; the appendix was swollen to twice its normal size, was black in color and dull and lusterless in appearance. There were numerous adhesions between the base of the appendix and the peritoneum forming the neck of the sac. The hernia was removed and the patient made a good recovery.

Hernia of the Ovary and Tube. Lieut. Cuff, in the *British Medical Journal*, December 7, 1918, p. 629, reports a case of hernia of the ovary and tube in a child, aged twelve weeks, in which operation was performed followed by prompt recovery.

¹⁶ Surgery, Gynecology and Obstetrics, April, 1918, p. 473.

Ventral Hernia. Greenwood¹⁷ describes a NEW METHOD OF OPERATION for large ventral herniæ, chiefly those following laparotomies. He refers to Stanton's report on 500 laparotomies, 24 of which developed ventral hernias, and states that 21 of the latter were due to sepsis. Greenwood accompanies his description with the accompanying illustrations, which give a fairly clear idea of the chief steps of the method.



FIG. 1.—1, Skin. 2, Subcutaneous tissue. 3, Rectus in sheath. 4, Transversalis fascia. 5, Peritoneum.



FIG. 2.

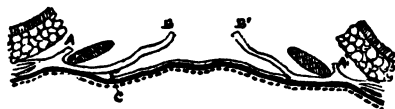


FIG. 3.



FIG. 4.

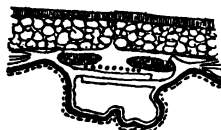
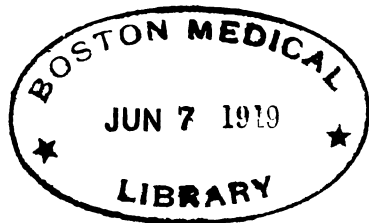


FIG. 5.

FIG. 20

The method itself appears to be a rational one, based on sound principles, the only objection being the use of silver filigree implantation, the disadvantages of which have been too frequently pointed out in previous numbers of PROGRESSIVE MEDICINE to repeat here.

¹⁷ British Medical Journal, September 21, 1918, p. 312.



SURGERY OF THE ABDOMEN, EXCLUSIVE OF HERNIA.

By ABRAHAM O. WILENSKY, M.D.

Military Abdominal Surgery. No two wars have ever been alike, and the experiences of the medical corps have differed in like manner and from a host of factors—character of the military operations, character of the terrain, rapidity of change of base, etc.—over which no premeditated control could be exercised. These conditions have impelled Cuthbert Wallace¹ to say, “that the surgical histories brought out after a war are largely a labor loss, if not a waste of time. A series of well-observed cases and the careful drawing of deductions, while the war is still in progress, are worth pages of statistics when the fight is over. Every effort must be made to summarize and render accessible the experiences of the early months for use in the later.” The unavoidable disadvantage of having a wounded soldier pass through many hands, from the first-aid station in the trench to the Base Hospital in the rear, is real and should be minimized by forwarding with the patient careful notes of the character of the injury and of the subsequent course of events. Any error or fault in technic can then easily be checked up, wherever it may occur along the line, and the necessary information can be passed backward from the Base to the Front. Such sympathy is very necessary for the smooth and efficient working of the medical service.

A large proportion of the soldiers wounded in the abdomen die on the field of battle, the causes of death being:

1. Hemorrhage from a wound of a large vessel—aorta, cava, renal, etc.
2. The extent of the wound and of the destruction in important organs resulting in an immediately fatal shock.
3. The association with other wounds—thorax, head, etc.—which latter are immediately fatal.

The rule is to consider every man with an abdominal wound picked up alive on the field as one most urgently needing attention, and after the first field dressing is applied—by the wounded himself, by a companion, or possibly by a medical officer—the man is transported as rapidly as conditions permit to the regimental station. The latter is situated somewhere in the trench system, and, even in quiet times, an hour or more is consumed before the post is reached.

The first formal care is rendered at this station. One is able to distinguish two groups among the wounded:

¹ War Surgery of the Abdomen, Philadelphia, 1918.

1. The frankly moribund cases, for whom nothing can and should be done. The chief cause for this condition is hemorrhage.

2. The remainder. Those in this latter group are redressed properly, fed, given hot drinks, and warmed up; enough morphin is given in appropriate cases to control the pain, and the first dose of tetanus antitoxin is administered. Then, after being adequately covered with hot blankets and surrounded with hot-water bottles, the wounded are transported by stretcher down the communication trench to the Advanced Dressing Station. The trip consumes another hour, under exceptional difficulties even more. The stop at the latter station is just long enough to rewarm the patient and to give him a warm drink. Abdominal cases are never retained here for any length of time, but are immediately evacuated by motor convoy to the Casualty Clearing Station (the first center equipped for operating). It is important not to disturb the patient any more than is absolutely essential in the transportation, and the rule followed is to keep the patient always on the same stretcher on which he had been originally placed until he is ready to be operated upon. When possible, a semi-reclining position is maintained.

The two immediately important factors are hemorrhage and shock. Hemorrhage will be discussed later. The amount of shock exhibited by any patient depends upon the following factors:

1. The extent of the wound and the amount of tissue destruction and upon the organ or structure wounded (solar plexus or adrenal).
2. The association with other wounds.
3. The length of time of exposure upon the field.
4. The amount and character of the transportation.
5. The severity of the hemorrhage.

The two threatening symptoms of shock which must be combated are chilling and hypotension. The one thing that can be done until the wounded reach the Casualty Clearing Station is to prevent the loss of heat; this is accomplished by keeping the men warmly covered with blankets or cotton wadding, and, when possible, with hot-water bottles; and by a simple lamp apparatus which delivers a current of heated air. Inasmuch as shock in abdominal wounds is distinguishable with difficulty from the collapse of intra-abdominal hemorrhage, this class of cases are immediately evacuated, the degree of shock not being regarded as a contra-indication. The motor ambulances which convey the wounded are closed vehicles and are heated by the exhaust gases from the motor—the idea again being to conserve all the heat possible.

The evacuation of the abdominal cases from the Front to the first center equipped for major operating (Casualty Clearing Station) is characterized by rapidity. A large proportion reach the operating table within six hours after the reception of the wound; a few in as short a time as four hours. It has become obvious that it is worth while taking risks in abdominal cases which one would not dare to take with others; the risk of waiting lies in intra-abdominal hemorrhage and to a much less degree in perforation.

With the establishment of the principle of early operation and the keeping of accurate records, certain errors prevalent in the early part of the war have been eliminated, and it is possible to estimate the number of abdominal cases reaching an operating center as not likely to exceed 2 per cent. of the total wounded received, provided no segregation of cases is practised. (Wallace.)

Wound Shock. The greatest stumbling-block to the successful treatment of wounds of any kind is shock. Probably this condition, especially when aided by hemorrhage—and this is very frequent with intra-abdominal wounds—is the most prolific single cause for the high mortality. The huge numbers of wounded in which shock becomes an important factor have created an extraordinary necessity, and, as a result, commissions have been appointed in England, France and America for the purpose of studying the problem and of devising means of successfully combating it. The problem is complex and many-sided, and much new information has been gained about its varied manifestations; but, up to the present writing, there is still much left to be learned in a therapeutic way.

The term “shock” is susceptible of much confusion, and Cowell,² who has contributed an important group of observations, suggests the term “wound shock.”

Wound shock may supervene early; that is, the man suddenly becomes pale, clammy and pulseless; and a low pressure may be found as soon as it is possible to make a reading, fifteen to twenty minutes after the man has been hit. To this group of symptoms with hypotension, the name “primary wound shock” is given. When, on the other hand, as a result of a long carry in the cold, or the onset of toxemia, or the presence of continuous slight hemorrhage, or combinations of these conditions, a man previously in good condition develops similar shock symptoms, a condition of “secondary wound shock” is said to exist.

In the front line trenches the conditions are for the most part unfavorable. Long spells of hard physical labor are repeated very often and are accompanied frequently with profuse sweating. Only short periods of sleep are available, and these generally are interrupted frequently. The food supply is insufficient; the water supply limited. During operations of any kind these conditions all become accentuated. For a large part of the year there is exposure to wet and cold.

Thus the soldier, who may be hit at any time, is likely to be in a state of fatigue, with a tendency to concentration of plasma, sluggish peripheral circulation, and with an accumulation of waste products of muscular exertion.

Evidence has been obtained which shows that in conditions of this kind at an advanced active sector the average systolic pressures of the blood were a little above the normal: that is, from 120 to 130 mm. With increased military activity the pressures showed a tendency to be higher;

² Journal of the American Medical Association, 1918, lxx, 607.

systolic pressures averaged 140 to 160 mm.; diastolic pressures, from 70 to 100 mm.; pulse pressures from 60 to 70 mm.

Cowell classified the cases as follows:

1. *Trivial Wounds.* In these a transient psychic disturbance may occur, and the man becomes pale and sweats. In a number, in whom fainting occurred, the pressure, which was taken as soon as possible after recovery from the faint, was found to be normal. In highly strung individuals an excitement stage may follow a trivial wound; in these, the individual "temperament" plays a prominent part.

2. *Moderately Severe Wounds.* In this group are included those wounds which cause a certain amount of damage to the tissues, but in which either a vital organ is not involved, or, if such is involved, the damage is slight, as in a small perforating wound of the abdomen; danger to life does not develop for a number of hours. In these cases, primary wound shock does not, as a rule, occur. After a lapse of time, and as a result of certain factors, which are avoidable, to a great extent, the symptoms of shock, as described above, appear, and the patient is said to be in a condition of secondary wound shock.

3. *Serious Wounds.* In the third group a serious surgical condition has resulted from the wound. The primary wound shock comes on very early and apparently in proportion to the gravity of the lesion. Into this category of serious wounds falls, naturally, a large group of cases in which the wound must, of necessity, prove fatal. Symptoms appear immediately. Such wound shock is likely to be accentuated in men possessing temperamental instability. After a few hours, unless recovery has first occurred, the condition merges into that of secondary wound shock, owing to the operation of those same factors—cold, pain, anxiety, etc.—enumerated in the second group.

The degree of shock can be readily estimated by the extent of the fall in blood-pressure; and the subsequent accentuation or amelioration of the condition is evidenced by corresponding changes in the arterial tension.

Cowell and Fraser³ were able to group the cases as follows:

1. In patients seen within six hours after being wounded, and with an intraperitoneal injury of a hollow viscus, the blood-pressure is low; in a series of cases of this description which were examined, the systolic blood-pressure varied from 50 to 100 mm. Hg.

2. When a period of from six to ten hours had elapsed, the blood pressure was generally found to have risen, because by that time the effects of the primary wound shock had begun to wear off; the rest on the stretchers, the warmth, and the morphine beginning to show their action.

3. At a period later than ten hours, the pressures are again low, and the change is apparently due to loss of blood and sepsis. Secondary wound shock is now present.

The character of the wounds was also compared with the fall of blood-pressure. It was found that perforating wounds of the viscera

³ Journal of the American Medical Association, 1918, lxx, 520.

which do not open into the peritoneal cavity, were associated with practically normal blood-pressures. Large wounds of the parietes were generally associated with lower blood-pressures than small wounds, even though the former may have produced much less visceral destruction than the latter. This was explained by Cowell and Fraser by the fact that in the former instance, peritoneal blood rapidly escapes, while in the latter the hemorrhage continues to be retained within the abdominal cavity. Corroboration of this explanation was found in certain animal experiments in which it was found that if the abdominal cavity contained much blood which was evacuated by a free incision, there was a rapid fall in blood-pressure as soon as the incision was made. If, on the other hand, there was no blood extravasation within the abdomen, the incision was followed by a rise of as much as 20 mm. in the blood-pressure.

During the course of the *circulatory failure in abdominal shock*, Wiggers⁴ was able to distinguish: (1) An initial stage lasting about thirty minutes during which the effective venous pressure and cardiac discharge are apparently not appreciably reduced, while the arterial pressure shows distinct changes which are not recorded on the ordinary manometers. (2) A progressive stage lasting two to four hours, during which effective venous pressures fall, cardiac efficiency becomes impaired, and the arterial pressures reach a low level. The heart action becomes accelerated. (3) A stage of complete circulatory failure, marked by a prolonged period during which effective venous and arterial pressures reach their lowest levels, and eventuate in death. The conclusion, which is in the ascendancy at the present time, is that the decreased venous pressure and the consequent reduction in minute output are the predominating factors in causing the pronounced fall of arterial pressure during the progressive stages of shock; that a reduction in peripheral arterial resistance initiates the fall of arterial pressure and the diminished filling of the arterial trunks before the effective venous pressure and the cardiac discharge are reduced.

The *variations in the morphological components of the blood* were investigated by Cannon, Fraser and Hooper.⁵ It was found that in cases of shock—seen at a Casualty Clearing Station—the red cell count of blood taken from various capillaries is higher than that of blood taken from a vein; the discrepancy is greater the more profound the shock, and frequently is as much as 2,000,000 corpuscles per cubic millimeter. Since the venous count is approximately normal, the condition is due to a stagnation of cells in the capillaries. After hemorrhage, and in cases of shock complicated by hemorrhage, the hemoglobin count is relatively low compared with the red-cell count; the same is true after an operation, except when hemorrhage occurs; in the latter, the count and hemoglobin content may be higher, and the increase is probably due to a loss of fluid from the body.

This condition in shock, when once established, is recovered from only gradually, the restoration to normal consuming two or three days. Dis-

⁴ Journal of the American Medical Association, 1918, lxx, 1332.

⁵ Ibid., 1918, lxx, 530.

appearance of the concentration is a sign of improvement. Continued concentration of the capillary blood beyond the period indicated accompanies a continued unfavorable clinical condition.

ACIDOSIS IN CASES OF SHOCK AND HEMORRHAGE. Kruglevsky⁶ has found that cases of low blood-pressure due to shock and hemorrhage have a diminished supply of available alkali in the blood. As a general rule, the lower the blood-pressure, the more marked the acidosis. The various phases of this phenomenon include an increased ventilation of the lungs (hyperpnea) induced by irritation of the respiratory center, and a resultant decreased tension of carbon dioxide in the arterial blood (acapnia). The last is followed by an apneic period until the normal equilibrium is established. A sufficiently marked increased ventilation of the lungs results in decreasing the reserves of oxygen. The insufficiency of oxygen during the apneic periods produces a certain asphyxia of the tissues, and the latter is accompanied by the formation of non-volatile acids; acidosis is thereby established. The acidosis of the blood and tissues deranges the venopressor mechanism, in consequence of which filtration, diffusion and osmosis, exceeding the limits of physiological functioning, draw out from the blood the greater part of its plasma, and induce an acute oligemia and stagnation of the blood corpuscles in the smaller arteries. Thus, in all the aspects of surgical shock, death occurs with the manifestations characteristic of shock from hemorrhage.

As a consequence of these phenomena, a theory, which has received much attention, has been advanced by Yandel Henderson,⁷ that shock is due to a reduction of carbon dioxide of the blood. Henderson produced a shock-like state experimentally by vigorous artificial respiration, and assumed that the condition resulted from the low carbon dioxide content of the blood. In all probability, however, the effect is due, not to this reduction, but to mechanical obstructions in, and the consequent failure of, the circulation. This theory was later modified by Henderson, Prince and Haggard.⁸ They found a condition of acidosis in the animals experimentally shocked, and argued that, since the blood in this state has a reduced capacity for carbon dioxide, the acidosis must of necessity be causing the acapnia.

It appears, however, from some work done by McEllroy,⁹ that these pathological findings, which together are spoken of under the term acidosis, are not the cause but are secondary manifestations associated with the conditions of shock.

The term shock, as used by the surgeon in describing a definite clinical condition, is, therefore, probably due to a number of different causes. In general, however, all cases may be included in two groups. One group contains the cases in which the clinical manifestation follows some time after the occurrence of the conditions incident to the shock. The other group includes the cases in which a severe or fatal condition

⁶ Russky Vrach, Petrograd (Abst., Journal of the American Medical Association, 1918, lxx, 1576).

⁷ American Journal of Physiology, 1908-1910.

⁹ Ibid., lxx, 847.

⁸ Journal of the American Medical Association, 1917, lxxix, 956.

supervenes immediately on receipt of the active agent. The symptoms produced are apparently due to a loss of circulatory fluid probably consecutive to, or associated with, a failure of the mechanism to control fluid volume. This fact seems to explain the good effect which is seen to follow the transfusion of blood or of blood substitutes. The part the nervous system plays in the cause of shock is not determined. Clinically, it seems to be definitely established by Mann¹⁰ that shock is responsible for death in some cases, and in such the mechanism seems to be of an inhibitory nature and involves a failure of physiologic compensation.

The Casualty Clearing Station. THE "RESUSCITATION WARD." However gently the wounded men may have been handled in the transportation, the condition of shock is, if anything, enhanced thereby, and upon arrival at the Casualty Clearing Station (the first station in the line of communication which is properly equipped for major operating) it is usually found necessary to improve the patient's general condition before subjecting him to the insult of a laparotomy. For this purpose a room is set aside at the Station manned by a competent and properly equipped staff, whose duty it is to bring the wounded around into operable condition. The measures used are, in general, those ordinarily employed for shock and any acute anemia, and include (a) infusions, (b) stimulating drugs and enemata, (c) morphine, and, if necessary and available, (d) transfusions of blood. The warmth of the body is conserved in every possible way, and in many of the stations arrangements are provided for heating the stretchers or tables upon which the wounded lie. The patients are also "cleaned up" in this room, but, as a general rule, the sicker the patient, the less cleaning up is done.

Experiences at the front¹¹ have demonstrated that: 1. In cases of profound shock accompanied by loss of blood, excellent results are obtained from the transfusion of blood. This measure is especially indicated in the first few hours after a wound in cases of grave hemorrhage (in pure shock the indications for transfusion are not yet thoroughly established). Robertson and Watson cite a large number of cases to emphasize the fact that many patients admitted in an inoperable condition from severe hemorrhage have been rendered operable by blood transfusion. To illustrate: The 68 cases cited by Robertson¹² comprised the following:

For primary hemorrhage, 57 cases were transfused. Results:

- (a) Life saving and evacuated in good condition, 36 cases.
- (b) Immediately beneficial, but death later:
 - from shock, 8 cases.
 - from gas gangrene, 5 cases.
 - from capillary bronchitis, 1 case.
 - from pulmonary embolism, 1 case.
- (c) No benefit, 4 cases.
- (d) Harmful (hemolysis with secondary hemorrhage), 2 cases.

¹⁰ American Journal of Physiology, 1908-1910, lxxi, 1184.

¹¹ Interallied Surgical Conference: Presse Médicale, 1918, xxvi, 193.

¹² Lancet, London, 1918, i, 759.

Donors should be tested for agglutinins and hemolysins and should be classified ready for use; fatal accidents have occurred from these causes but the danger of their happening is relatively small. In emergency cases at an advanced post it may be disregarded; strict asepsis is, however, indispensable, and the transfusions should not be attempted unless facilities are present for doing them properly. Tests of blood kept for several days have been satisfactory; and the method of using this "stored" blood* should render immeasurable service at the posts during intense military activity.

Direct methods of blood transfusion are not feasible, nor even desirable at the Front. Of the indirect methods there are three which are in general use at the British centers: (a) The method of syringes and cannulas; (b) paraffined glass containers; (c) anticoagulants—citrate method.

2. There exists an urgent need for injection fluids that can satisfactorily replace blood. After active fighting, the Casualty Clearing Stations become crowded with exsanguinated men who would undoubtedly respond to blood transfusion; neither sufficient time nor a sufficient number of donors are, however, ever available.

Rous and Wilson¹³ have shown that the animal organism can withstand an abrupt reduction of the normal hemoglobin content to almost the low levels which are found in the chronic anemias, provided the blood bulk is maintained. Abel and his co-workers have shown that great losses of plasma can be repaired by the body, also provided the blood bulk is maintained. Taken together, the facts show that however desirable transfusion of blood may be, it is not essential to recovery from the most severe hemorrhages, if the blood bulk is restored in other ways.

Of the several substitutes for blood which have been suggested, Bayliss's 7 per cent. gum acacia solution is the best. In less needy cases a 2 or 3 per cent. gum acacia solution, or Hogan's 2.5 per cent. gelatin solution are preferable to salt solution. The response to these weaker solutions is only momentary, and when more permanent betterment is to be expected, solutions of at least 5 to 7 per cent. strength must be employed.

In milder cases of shock and hemorrhage, infusion with hypertonic salt solution is useful. Results obtained with infusions of physiologic sodium chloride solutions have been unsatisfactory. The rise of blood-pressure obtained with any of these solutions may be enough to tide a patient through an operation, and, if the source of the trouble can be removed, the tension will remain supported.

The wounded are held in the "resuscitation" ward for a number of hours, and, as soon as their general condition becomes satisfactory, they are transferred directly to the operating room which is immediately adjoining. This preliminary treatment is of the utmost importance, and its necessity cannot be overemphasized; few operations are undertaken without it, since it brings a much larger number of the

* The use of "stored" blood is apt to cause excessive post-transfusion reactions.

¹³ Journal of the American Medical Association, 1918, lxx, 219.

wounded into condition for operation and helps one to distinguish those that will not withstand the shock of laparotomy. It is usually found that if the "resuscitation" treatment, outlined above, does not bring about some improvement in the patient's condition, it is useless to operate. This rule is, however, frequently broken because of the difficulty of excluding the effects of hemorrhage.

Nature of the Projectiles Used. **BULLETS.** These are almost always pointed, and are made of composite materials or alloy. They are liable to great distortion before inflicting the wound, to marked spinning due to an inherent instability, or to deflection from surrounding objects; for the occurrence of the last, there is abundant opportunity in the trench and in the frequent street fighting. Wallace believes that explosive effects are rare except when a hard bone is hit; otherwise one sees either a small track of an undeformed bullet, or the larger, irregular wound of a spinning, deflected, or deformed bullet.

SHELLS. These are of various kinds, and the wounds are caused by fragments of the casing (high explosive shells) which (fragments) in abdominal wounds are most often less than one and a half inches in diameter; or by the contents of the shell (shrapnel balls); or by the shell caps, which more often cause contusions only.

Bullets and high explosive shells account for the largest number of wounds. More shell fragments than bullets are retained in the body.

BOMBS AND GRENADES. These are fired either by hand or from trench mortars, and consist of a thin casing, filled with a high explosive charge, which, on bursting, breaks up into a large number of very small fragments each of which has a high penetrating power. The fragments are most often retained in the body.

Wallace speaks of the possibilities of armor in protecting the body. Undoubtedly it would have much the same good effect which the wearing of helmets has afforded to the head.

Bayonet abdominal wounds are nearly always fatal.

The Regional Incidence of Abdominal Wounds. Wallace gives figures to show the relative proportions of the wounds on the anterior and posterior aspects of the abdomen.

The apparent escape of the mid-positions is due to the fact that the proportion of immediate deaths in wounds near the mid-line is extraordinarily high on account of the presence of the spine and great vessels.

Wallace also shows the relative proportions of the fatal and operable cases as compared with the missile tracks.

Anteroposterior wounds above the stomach level are among the less serious wounds; those in the right hypochondrium are usually liver wounds; those in the epigastrium either go through the gastrohepatic omentum or perforate the opposing walls of the stomach at the lesser curvature, and, when high up, they become very serious wounds to treat. Wounds from side to side at these levels, when sufficiently far back, are very serious from vessel injury. Oblique wounds from side to side perforate the epigastrium and hypochondrium and are much more serious than the others. Vertical wounds are also found, in which

the wounds of entrance and exit are on the same body surface; on the right side they may be pure liver wounds; on the left side, spleen, stomach, liver and colon may be injured; on the lateral surfaces they appear first as thoracic wounds. Single wounds of entry are sometimes found on the lateral and posterior aspects or in the loin; on the left side these are more dangerous.

Wounds below the umbilicus are very fatal because of the frequency of small intestinal injury. Toward the sides or in the loins, the colon or the kidney, or both, may be lacerated; or there is much damage in the retroperitoneal space with a wide-spreading hemorrhage. The latter wounds are very serious owing to the proximity of the peritoneum. The dangers include peritonitis from opening of the peritoneum or retroperitoneal phlegmon.

Wounds below the spines of the ilia are most dangerous and include wounds through the buttocks, hips and thighs. In the hypogastric region small intestinal injury is common. Anteroposterior wounds may involve the colon and rectum, and the bladder; side-to-side wounds may involve the cecum, small gut and pelvic or iliac colon. The large vessels may be torn and fatal hemorrhage ensue. The most dangerous are the semivertical wounds entering from below, buttock, perineum or thigh, and with these the possibility of an intra-abdominal lesion should never be forgotten.

Wounds may occur independently of the missile, and are due to the contusion in the immediate neighborhood or to indriven fragments of bone. Hollow, as well as solid, viscera may be so injured. Intra-abdominal injury may also occur without penetration, and the only external evidence is a contusion of the abdominal wall. The hollow viscera are much more prone to this accident when they are in a distended state.

The relative frequency with which the viscera are injured is shown in the following table taken from Wallace:

Small gut	363 times
Colon	252 "
Liver	163 "
Stomach	82 "
Kidney	74 "
Spleen	54 "
Bladder	45 "
Rectum	21 "
Pancreas	5 "
Ureter	3 "

The Diagnosis of Abdominal Wounds. Lockwood, Kennedy and Maché¹⁴ roughly distinguish those that are limited to the abdominal wall and those that penetrate into the peritoneal cavity. Visceral extraperitoneal wounds have given symptoms more marked, more lasting, and more alarming than parietal injuries. These are the difficult cases and it is frequently difficult, if not impossible, to diagnose

¹⁴ British Medical Journal, 1917, i, 317. Walters, Rollinson and Jordan: Lancet, London, 1917, excii, 207. Fraser and Drummond: British Medical Journal, 1917, i, 321.

accurately whether the wound has, or has not, penetrated through the peritoneum.

The general symptomatology of all abdominal wounds is practically the same as in civil life, and includes: (a) Rigidity of all or part of the abdominal wall; (b) localized or generalized tenderness; (c) diminished dulness over the liver; (d) vomiting; (e) small and rapid pulse; (f) facies abdominalis; (g) stoppage of flatus and feces which persists for more than twenty-four hours; (h) traumatic (primary or secondary wound) shock.

The importance of determining the presence and character of the rigidity of the abdominal wall in all wounds of the entire trunk, including the buttocks and perineum, and in wounds of any of the limbs near to the trunk, cannot be overemphasized.

Contusions and wounds of the abdominal wall are accompanied by a localized rigidity which, as a rule, does not give rise to any confusion. Wounds of the pelvic floor cause reflex spasm of the anterior abdominal wall; this may be present with an unpenetrated peritoneum. A one-sided rigidity is found frequently with retroperitoneal hemorrhage, especially in the lumbar spaces, and with or without injury of the kidney. Bleeding from a wound of the mesentery or omentum, when considerable blood has accumulated intra-abdominally, is also fairly often accompanied with rigidity.

Injuries of both the solid and hollow viscera are associated with a varying amount of rigidity. As a general rule, that due to injury of a solid organ tends to localize itself in its immediate neighborhood, or to its appropriate side of the abdomen, and the degree of the spasm is often proportionate to the amount of intra-abdominal or retroperitoneal hemorrhage. That due to a perforation is diffuse and unmistakably board-like. The latter is largely independent of the stage of peritoneal infection, and may be pronounced when there are little or no naked-eye appearances of peritoneal inflammation; it is usually accompanied with much pain and tenderness.

The difficulties of establishing correct indications in thoracic injuries are enhanced by the frequent occurrence of abdominal rigidity. The latter may be due to an increasing hemothorax, to a piece of loose shell in the pleural cavity, to injury of the diaphragm, or to an intra-abdominal injury. Occasionally a study of the track of the bullet or shell fragment will give an indication; most often it will not.

In any given case the making of the proper diagnosis, and especially of the proper therapeutic indication, depends very largely upon experience. Any one or more of these signs may show in an abdominal wall injury, but the occurrence of all together is very uncommon. Repeatedly, the experiences of the war have demonstrated that these symptoms can occur in lesions which do not involve the peritoneal cavity. In any given case there can be no certainty regarding the identity of the lesions, and the symptomatology is of such a nature as not to permit a policy of abstention to be followed. The cases of intraperitoneal wounds observed have clearly shown that there are no early pathognomonic signs which differentiate them from non-penetrating injuries;

and the special conditions in which a surgeon is placed at the Front oblige him to waive indications and to proceed at once to operate in order to dispel any doubt.

All signs of peritonitis which are observed in patients without peritoneal perforation are found also in true perforation; and it is only a question of degree which differentiates the one from the other. There is perhaps only one sign which denotes intraperitoneal perforation—that is, a board-like rigid abdomen, especially when accompanied by the costal type of respiration. But even this symptom cannot absolutely be relied upon.

Regarding intraperitoneal wounds without perforation of the digestive tract, operation does not seem necessary in a large proportion because of the numbers of spontaneous cures. However, here again, considering the circumstances of time and place at the Front and the arrival of the wounded in the hours immediately following the traumatism, when, frequently, there are no pathognomonic signs demanding intervention, and that a number do need the laparotomy because of the presence of a perforation—an exploratory laparotomy should always be done.

Prognosis in Abdominal Injuries. The prognosis in abdominal injuries depends upon the following factors:

1. The extent of the injury of the gastro-intestinal tract or of the solid parenchymatous organs.

2. Hemorrhage and shock.

3. Infection.

4. Concomitant injuries in other parts of the body, such as the head or the thorax.

5. Manner and rapidity of transportation.

6. Rapidity with which effective treatment is instituted.

7. Late complications.

It seems better not to insist upon operation under the following conditions:

1. In thoraco-abdominal wounds on the left side when the wound is mostly thoracic.

2. After twenty-four hours when peritonitis is present.

3. When the patient is in very bad condition, or when the lesions are multiple and grave.

For the latter, Okinczyo and Clavaud¹⁵ point out that a decision as to whether or not to operate should not be made until the wounded has had the benefit of the "resuscitation ward" treatment for from one-half to three-quarters of an hour (more than this predisposes to hemorrhage). If the radial pulse is over 120, or is imperceptible at the end of this time, there is little hope in intervention.

A complete contra-indication to operation is found in:

1. A co-existing chest wound definitely involving the lungs, with hemoptysis or surgical emphysema.

2. A co-existing spinal cord lesion, with paralysis.

¹⁵ Archives de Médecine et de Pharmacie Militaires, Paris, 1917, lxviii, 833.

General Technic of Operation. Very few, if any, operations are undertaken without the aid of the x-ray. This furnishes information as to whether any missile has been retained; and when only a wound of entrance is present, the finding and location of the retained bullet or shell fragment enable one to determine the track of the missile and to plan one's incision in accordance thereto.

In multiple wounds, those that are bleeding most actively are looked after first; those on the back of the trunk are treated before those anteriorly, in order to avoid any deleterious effect which rolling a patient over on his belly after a laparotomy is said to cause (Wallace). When a limb wound co-exists which demands amputation, it is wise to do the abdominal operation first and take the risk of leaving the amputation to be done a few days later.

The usual steps in the operation comprise the following:

1. *Anesthesia.*¹⁶ Ether is most commonly used. Gas and oxygen is also extensively employed. Much use is made of local anesthesia whenever conditions lend themselves thereto; for this purpose, novocaine is generally preferred. Gas-oxygen anesthesia is especially useful in anesthetizing patients who are in bad condition from gas gangrene, sepsis, or shock. It is also very useful in the wards for painful dressings. While not quite so satisfactory, on the whole, as gas-oxygen, ethyl chloride serves a useful purpose for short operations and is very convenient and transportable.

Soldiers, as a rule, take large amounts of ether with the open method, and the excitement stage is very unpleasant for the nursing sisters. Closed etherization with nitrous oxide or ethyl chloride as a preliminary was found much more satisfactory for war surgery. The only drawback is the necessity of cleansing the inhaler. The dosimetric method of administering chloroform was the most satisfactory form of anesthesia with the latter drug. It proved very economical, pleasant, safe and free from untoward results, such as vomiting and pulmonary complications. The only drawbacks were the expense of the apparatus and the slowness of induction. Intratracheal etherization proved very satisfactory for certain operations and also where there was a shortage of assistants. The Chevalier Jackson instrument, for introducing the tracheal tube, was found to be ideal for this purpose. Very little spinal anesthesia is used.

2. *Disinfection of the Field of Operation and of the Wounds.* The usual routine begins with soap and water and is continued with ether or alcohol, and with tincture of iodine or picric acid. Picric acid is cheaper than iodine and is non-irritating.

3. *The missile tracks are excised*, layer by layer, and, if possible, in one piece. Every precaution is taken to prevent the conversion of an extraperitoneal into an intraperitoneal wound. This desideratum is easier of accomplishment in wounds of the anterior abdominal wall, and the necessity for its accomplishment is much more stringent and important in wounds of the loins and back. In the latter type of

¹⁶ Transactions of the Interstate Association of Anesthetists, Journal of the American Medical Association, 1918, lxxi, 1606.

wound one frequently finds a smaller or larger tear in the peritoneum, or some frank intra-abdominal lesion; and in these the intra-abdominal complication converts an otherwise simple into a very dangerous wound. If the wound, on exploration, proves to be entirely and definitely extraperitoneal, and the clinical signs and symptoms give one sufficient assurance, the peritoneal cavity is not opened and the wound of the soft parts is treated in accordance with the general surgical principles in use with wounds of any other part of the body.

4. *The Abdominal Incision.* For reasons which have been previously detailed, every intra-abdominal injury is explored completely. It is usually considered wisest to disregard the wound entirely and to plan one's incision in accordance with the lesion one expects to find. For general purposes, a median or paramedian incision is best, and it is made of sufficient length (6 to 8 inches) to enable one to work with ease and a fair amount of speed. Speed is essential not only for the good of the patient being operated upon, but also because of the large number of wounded, all badly in need of care, who are awaiting attention.

As a general rule, this vertical incision is the most useful one; one can enlarge it quickly and with a minimum of manipulation upward and downward so as to reach structures at the upper and lower limits of the abdominal cavity; and one can reach equally well to one or the other side. It can be closed more rapidly than most other incisions. Under special conditions other incisions are preferred.

In cases in which all the damage lies in the loin, the incision is planned directly over the affected area either as the usual oblique kidney incision or as a transverse incision. Frequently, however, the locality can be, and is, satisfactorily handled from a vertical incision at the outer border of the rectus muscle.

In the upper abdomen, a transverse incision (Sprengel) gives a very good exposure. The difficulties with it, however, are twofold: (a) It takes a much longer time to make and to close it; and (b) if, during the operation, one must look after injuries in a part of the abdomen difficult to reach through the transverse cut, it becomes necessary to close it entirely and begin again with another entirely new incision—all of which consumes much time and contributes to additional shock. A transverse incision is frequently useful in lumbar wounds.

Whenever possible, the incision is sutured in layers. This is not, however, always feasible; (a) because of the threatening condition of the patient, and (b) because of the press of other work. In these, the abdomen is closed with through-and-through sutures. A large proportion of the incisions suppurate.

5. *The Control of the Hemorrhage.* Immediately upon opening the abdomen, the first and imperative task is to determine the presence and amount of any active hemorrhage and to control it. In controlling the bleeding from vessels in the parietes or mesentery, the usual methods are available and sufficient. In mesenteric wounds care is taken not to sacrifice any more than is absolutely necessary because of the danger of forcing a resection of the gut.

For the control of hemorrhage from any parenchymatous viscus,

the methods described by Risley¹⁷ are especially good. Strips of muscle tissue are interposed which are taken from the patient's own body. Strips of fascia, or fat, and broad flaps of omentum act to a more limited extent; in the liver, these are all-efficient. All of these unite quickly and readily, and give no ill effects later.

In any intra-abdominal or intrapleural hemorrhage of considerable size, the blood remains fluid for an extraordinary length of time; and when it is fairly clean, it can be utilized, when the patient's condition calls for it, for autotransfusion. The blood is carefully collected, filtered rapidly through gauze to remove any clots, and, after having added to it the requisite amount of sodium citrate solution (0.2 per cent.), is administered as in any citrate transfusion. Alessandri¹⁸ quotes Kreuter's case in which a liter of blood was collected from a ruptured liver and reinjected into a vein. In other cases, the source of the blood was a hemothorax and a ruptured extra-uterine pregnancy. In some of the cases the blood was first defibrinated; in other cases the blood was kept outside of the body for several hours before being used. The immediate results were good.

Blood from any of the parenchymatous viscera, or from the large vessels, or blood which has accumulated intrapleurally, is practically sterile; and what little contamination occurs is abundantly rectified by the natural protective antibodies of the blood. Foreign bodies of any kind (missiles, pieces of clothing, etc.) increase the risk of infection very much; and the presence of any intestinal perforation creates a definite contra-indication. One should not, however, be too timid, especially in war work.

6. *The Treatment of the Peritoneal Cavity.* Flushing of the abdomen at the time of operation is recommended by some of the men and for this purpose ether seems to be preferred. As a general rule, however, irrigation is not practised. Drainage of the general peritoneal cavity (pelvic or loin drains, etc.) is provided by only a minority of the operators; the majority believe it useless.

The Postoperative Course. According to Wallace,¹ the postoperative course is very variable. Some of the cases do well for the first few days and then do very badly; others show a progressive improvement; a number vary to a marked degree from day to day, so that the ultimate result is always in doubt. Pneumonias are frequent.

A troublesome postoperative complication, for which one must always be on the look-out, is secondary venous hemorrhage. Fortunately, with improvement in the technic, these are becoming more and more rare. Razzaboni¹⁹ believes that bacterial action is generally responsible, the bacterial proteolytic ferments weakening the damaged wall of the vein. The hemorrhage generally occurs suddenly, after some effort or manipulation in the region of the wound. The symptoms are those of any internal hemorrhage. The usual methods of securing hemostasis are available.

¹⁷ Surgery, Gynecology and Obstetrics, 1917, xxiv, 85.

¹⁸ Clinica Chirurgica, Milan, 1918, xxv, 504.

¹⁹ Riforma Medica, Naples, 1918, xxxiv, 322 (Abst., Journal of the American Medical Association.)

Liver Wounds.²⁰ The liver was found wounded 148 times in 965 abdominal operations. (Wallace.¹) In the liver, the results of high velocity projectiles give wounds which are favorable for healing. The wounds usually correspond with the type of missile causing them. The typical injury is a perforation surrounded by radial fissuring of wide extent. Tangential and shell wounds give irregular lacerations and are not so favorable for healing; pieces of liver may be completely torn away. Subcapsular injuries may also be present; there are localized hematomata or widespread infiltrations of the organ with blood. The injury may be aggravated by indriven fragments of ribs. Simultaneous injuries are frequently present in the thorax (right lung or chest wall), in the right kidney, or in the stomach or intestines. Other curious complications have occurred, as in one case in which a fragment of shell perforated the liver, entered a large hepatic vein, found its way into the vena cava and was discovered at the postmortem examination in the right ventricle of the heart.

The symptoms, which may be slight or severe, are those which follow any abdominal trauma, and include pain and localized rigidity. The important facts in diagnosis are (a) the location of the wound and the probable trajectory of the missile; (b) shock and signs of moderate hemorrhage; (c) an early leukocytosis; (d) dullness in the right flank; (e) rigidity with a flat abdomen; (f) shallow costal type of respiration. Jaundice is either not seen or is very slight and evanescent (Wallace¹) and has no significance.

The amount of hemorrhage, except when a large vessel is torn, is inconsiderable; and the bleeding occurs a little at a time and gravitates downward in the right lumbar gutter. In these, rigidity is a late phenomenon—unless there are other injuries—and is present only in the right flank.

Success in the treatment of liver injuries depends, as in all other war wounds, upon prompt and efficient treatment. The usual practice can be outlined as follows:

1. As a general rule, wounds of the liver are to be determined to be such only and treated expectantly. When the wound is small, spontaneous healing occurs. All that is necessary is to explore and clean up the bullet track. If there is a probability that one is dealing with a through-and-through rifle bullet wound, even this slight procedure is unnecessary. Symptoms of considerable hemorrhage call for inspection of the wound and the control of the bleeding. The methods of arresting liver hemorrhage include: (a) Packing with gauze; (b) suture; (c) actual cautery; (d) steam or hot compresses; (e) digital compression of the liver hilus (Tuffier); and (f) compression of the ligamentum hepato-duodenale by a special clamp. The methods of Risley, spoken of previously, are also valuable.

2. In tangential shots, especially those produced by artillery, the irregularly torn sinus is exposed, bone splinters of ribs and all necrotic tissue are removed, and the wound is loosely tamponed.

²⁰ Archives f. klinisches Chirurgie, 1916, cvii, 509. Hitzrot: Annals of Surgery, 1917, lxvi, 251.

3. Complications in the pleura and abdomen are treated according to rule.

4. Extensive tearing or rupture of a bile vessel of some size is followed by the escape of bile into the abdominal cavity; this has caused peritonitis and death. The escape of bile, however, from moderate sized raw areas is inconsequential. The indicated treatment is a tamponade of the raw area with wide drainage. The repair of injuries of the gall-bladder, or common, or hepatic, bile ducts is carried out along general surgical lines and includes suture and drainage.

The dangers of liver wounds are found in the complications. These include: (a) primary or secondary hemorrhage; (b) peritonitis from associated intra-abdominal injuries; (c) chest complications; (d) necrosis and abscess in the liver; (e) thrombosis of the large vessels; (f) injuries in the kidney; (g) intestinal obstruction; (h) embolism by plugs of liver tissue.

The occurrence of secondary hemorrhage is indicated by sudden pain, abdominal distention, and rise of temperature and pulse. If there is much accumulation of blood between the dome of the liver and the diaphragm, hiccough may be a prominent symptom. "With these general symptoms a localized swelling generally develops, if the patient survives the immediate loss of blood, and this may be indistinguishable from a secondary abscess." (Makins.)

The mortality of liver wounds is given by Wallace as follows:

Treatment.	To base.	Died.	Not known.
Complicated wounds; operation	14	26	4
Uncomplicated wounds; operation	72	32	
No operation; no indication	23		

Wounds of the Spleen.²¹ In 965 abdominal operations, the spleen was found wounded 54 times, and in 32 cases it was the only organ injured. (Wallace.) The complicating injuries, which are found, involve the stomach, the intestines, the left kidney, and the left thorax (chest wall, pleura or lung).

There is much difficulty in diagnosing an injury of the spleen. There may be: (a) No symptoms referable to the spleen; (b) symptoms of peritonitis; or (c) late symptoms of hemorrhage. Unless the splenic vessels are torn, in which case death occurs very frequently on the field, the bleeding is slow and moderate in amount, and the symptoms are referable to the left flank. It may not be apparent for hours or days, and then it proves fatal, with a peculiarly rapid and malignant course. In diagnosis, a great deal of reliance has been placed on the x-ray examination; this can give most definite information in demonstrating a projectile within the spleen.

The size of the projectile injuring the spleen is of great importance. The organ is friable and gorged with blood; small fragments may tunnel through it without causing serious damage; but if the projectile is large, the organ ruptures. In addition to direct wounds, there are cases of

²¹ Bulletins et Mémoires de la Société de Chirurgie de Paris, 1917, 43.

rupture caused by projectiles which do not directly injure the spleen. Such tearing or disorganization, which may be extensive, is due to the concussion of an exploding shell or to violent muscular contraction caused by large fragments striking in the vicinity of the spleen.

Splenic wounds can, therefore, be: (a) Superficial furrows; (b) punctiform wounds; (c) tunnel wounds without rupture; (d) frank ruptures which divide the splenic substances more or less completely; (e) tears of the pedicle; (f) general disorganization.

The peritonitis due to isolated splenic wounds is mostly localized to the splenic region. General peritonitis, with wounds limited to the spleen, is rare. Subphrenic abscess is frequent; the progress of such abscesses is very rapid and extraordinarily malignant; they may rupture into the thorax and give rise to pyothorax.

Although there are cases of spontaneous recovery from splenic wounds, the usual outcome, when left alone, is an eventual fatality from late hemorrhage or infection. Conservative measures should be employed at first. In bad cases, or whenever one is not certain of the hemostasis, splenectomy is the safest measure. Associated lesions are treated appropriately.

Splenic wounds can be reached through a vertical incision at the outer border of the rectus, or through an obliquely placed opening parallel to the costal border. For complicated wounds—and most splenic wounds involve thorax and abdomen—the incision recommended begins at the orifice wound and descends vertically or obliquely so as to cut the costal circle perpendicularly. It becomes a left laparotomy directed toward the anterosuperior iliac spine. A couple of ribs are sectioned and removed, and the thorax is opened. Then the diaphragm is cut from its costal attachment to the required depth, and the parietal peritoneum is opened as much as required. This incision gives abundant access to the thorax and abdomen, and allows of treatment of both pulmonary and intra-abdominal lesions. The diaphragm is later sutured and the abdomen and thorax are closed in the usual manner.

The chief causes of death in splenic wounds are shock and hemorrhage, both of which are often due to associated injuries. In uncomplicated wounds the mortality is approximately 50 per cent. (Wallace.¹) In the latest reports of Duval and Depage, the percentage of recoveries after operation varied from 62 to 75 per cent.

General Considerations with Injuries of the Alimentary Canal. A man may have a severe injury of the alimentary canal without penetration of the peritoneum. Thus, a loop of gut may be completely divided by the force of impact, or the violence of the jarring may rupture the stomach, which, at the moment, is in a distended state. In hollow organs, the production of explosive effects depends on their contents, other things being equal. Such effects from rifle bullets are not observed in the stomach or intestine, by reason of the compressible air and gas which they contain. Contusions, unattended by breach of surface, found not rarely in such organs, are possible from their extreme mobility and compressibility. The longitudinal wounds produced at times in the intestines by intact bullets are explained by the wall having

been struck axially. In the case of the bladder, the contents of which are compressible, explosive results are now and then encountered.

With any hollow viscus injury the danger lies in infection, and it is imperative that the wounded reach the Casualty Clearing Station as rapidly as possible. A large number reach the operating table in from four to six hours; many more in from twelve to twenty-four hours; some are discovered on the field, or it is impossible to reach them for thirty-six hours or more after being wounded. With each of these conditions the treatment varies. As a general rule, the more quickly the wounded are transported, the more certainty of their being operated upon; with the late arrivals the policy is more expectant, but, even with these, operation is frequently advisable if the general condition of the patient warrants it.

In cases with a protrusion of a viscus, the diagnosis is simple. The most important point is the condition of the protruding viscus—whether strangulated or injured. If neither, the prognosis is fairly good. If a resection is necessary, a fatality nearly always follows. Projecting omentum is not a serious condition in itself; it indicates a visceral injury and serves as an indication for operation.

The most difficult cases are those in which the diagnosis must be made from the symptoms and physical findings alone. Pain is uncertain and misleading. Vomiting is particularly common with stomach injuries. A history of the passage of flatus since the reception of the wound is against any wound of the colon, especially of the descending colon. A normal facial appearance contradicts any bad peritonitic condition. Of the various signs, rigidity is most important, and a board-like rigidity almost always indicates a perforation. The percussion signs are valueless; and a rectal examination is seldom of help, unless the wound is within reach of the finger. A rising pulse-rate, in the absence of increasing temperature, is usually an indication to operate. Every case is judged on its own merits. Cases above the thirty-six-hour limit are watched for a number of hours unless the indication to operate is imperative. In any case, those in best condition and the most hopeful are taken first, and the doubtful cases are left for the last; frequently developments occur which make a decision easy.

During the laparotomy, a complete examination of the intestinal canal is made in an orderly and routine manner. One routine recommended is as follows: The ileocecal region is examined first, then the small intestine in short lengths of a foot or two, the uninjured portions being rapidly returned into the abdomen by the assistant. When a tear or other lesion is discovered, the part is retained outside the abdomen, the position of the first hole being marked by a clamp or in some other manner. The transverse, ascending and descending colon and the sigmoid are next examined, attention being also given to the flexures; the rectum is palpated last. This is a very good order, but individual operators vary this to suit their habits. Frequently, the character of the fluid in the abdominal cavity enables a quick decision as to the location of the major injury. Frequently a missile is found in Douglas's pouch; it is never neglected to palpate this region thoroughly.

Spontaneous Healing of Wounds of Hollow Organs. The possibility of spontaneous healing of intestinal wounds was investigated by Drummond and Fraser.²² Employing hares, cats and dogs for this purpose, they found that bullet wounds of the intestine could be very closely simulated by cutting the intestinal wall with small, sharp scissors. Single artificially made wounds of small size underwent spontaneous healing, irrespective of the portion of the intestinal tract in which they were made. Multiple small experimental wounds occasionally were recovered from, but if too numerous, a fatality ensued. It was found that wounds of the ileum showed a greater tendency to spontaneous recovery than any other part of the intestinal tract. In the absence of omentum, the spontaneous closure of intestinal wounds occurred by the plastic adhesion of neighboring coils of intestine. Spontaneous closure was hastened when omentum was brought into contact with the injured part. At the end of three days the points of adhesion were limited to the actual area of intestinal perforation. At the end of seven days a vascular anastomosis had occurred between omentum and intestinal wall. The mucous membrane at the point of injury remained prolapsed for about a week, in this way blocking up the aperture to some extent. It eventually becomes replaced by a plug of fibrin. At the site of perforation there tended finally to be a small sacculation of the mucous coat through the unsupported gap in the muscular tissue. Large areas of stomach wall could be replaced successfully by omental tissue, but restoration of the stomach epithelium did not appear to occur.

Stomach Wounds. Injuries of the stomach were found 82 times in 965 operations (Wallace). The wounds differ very widely, depending on the static condition of the organ; and any one of the following may be found: (a) Exposure and contusion of the stomach wall without penetration; (b) small perforations due to bullet wounds; (c) larger openings with a more extensively bruised margin due to shrapnel balls; (d) irregular wounds caused by shell and bomb fragments; (e) linear wounds; (f) linear or V-shaped wounds of the curvatures made by obliquely directed and striking missiles; (g) combinations of these various forms. The injury may be limited to the posterior wall. In the larger linear wounds the mucosa everts considerably; occasionally it helps to form a valvular opening and prevents the escape of the stomach contents.

The character and amount of the fluid found in the abdomen vary, naturally, with the previous content of the stomach and with the length of time which has elapsed since the immediately preceding meal. It is important to know that the outpouring may take place into the lesser sac even in the presence of concomitant injuries of the opposing walls of the stomach, or through a rent in any of the omenta.

Wallace speaks of gangrene of the stomach wall resulting from extensive wounds of the gastrohepatic omentum.

The most frequently associated wounds are those in the intestines, both small and large, and as far as the pelvic colon. Wounds of the liver

²² *Journal of Pathology and Bacteriology*, 1917, xxi, 457.

are next in frequency; then spleen and kidney and pancreas. The combination of splenic and stomach wounds seems especially fatal.

Hemorrhage is a constant feature of stomach wounds and may be intragastric or intraperitoneal. It is usually severe.

The walls of the stomach are so voluminous that the matter of closing any perforation or tear in the body or antral portions is usually a simple matter. In an emergency, one layer well applied is sufficient; two layers are, however, preferred. The suture line can be further guarded, if necessary, by a flap of omentum. Absorbable sutures are preferred; unabsorbable sutures may give trouble later on. If the injury is at the pylorus or involves the duodenum, the proper repair may compromise the lumen, or the operator, in view of the local conditions found, may feel that the suture line is insecure; in these instances gastro-enterostomy is necessary, aided, perhaps, by some form of exclusion (the simplest method is the string method). The difficult injuries for repair are those situated near or on the lesser curvature and at its cardiac end. In any case, the finding of only one perforation indicates that another must be present unless the missile is found within the stomach.

Wounds of the stomach very commonly complicate thoracic injuries. When the wound is in the fundus portion of the stomach, the necessary repair can be very easily made through the thoracic route, and an additional laparotomy is not needed. After the thorax is open, a sufficiently long incision is made in the diaphragm through which the stomach is drawn up into the thorax. The necessary repair having been made, the stomach is replaced into the abdomen, the required drainage is provided, and the diaphragmatic incision is closed with catgut sutures. The thoracic wound is then closed in the usual way.

The prognosis depends on the severity of the hemorrhage and on the character of the associated injuries. The common complications include secondary hemorrhage, pneumonia, and gastric dilatation. Subdiaphragmatic abscesses are rather uncommon.

According to Wallace, the mortality in all stomach cases is 60.9 per cent. In uncomplicated stomach wounds, the mortality was 52.7 per cent.; in those complicated with other hollow viscus injury, the mortality was 77.8 per cent. In 29 fatal uncomplicated cases the actual causes of death were as follows:

Shock and hemorrhage, 15 cases.

Peritonitis, 5 cases.

Lung trouble, 2 cases.

Gas gangrene, 3 cases.

Wounds of the Small Intestine. The following figures regarding the statistics of small intestinal wounds are taken from Wallace.¹ In 965 operations the small intestines were found injured 363 times; in 255 it was the only organ injured. The duodenum was wounded 16 times; ileum and jejunum seem to be injured about equally often. Injuries in the upper half of the small intestines are less serious than those lower down. The complicating wounds were distributed as follows: Stomach 19 times; colon 89 times; rectum 4 times; liver 8 times; gall-bladder 2 times; spleen 3 times; kidney 7, and bladder 16 times.

Wounds produced by bullets are more clean-cut than those produced by shell or bomb fragments. The shell wounds are usually commensurate with their size, while bomb wounds consist of numerous very small perforations, closely grouped together in a short segment of bowel. With bullet wounds the extent of the damage frequently depends on the static condition of the loop; thus, a bullet which makes a small, clean perforation in a relaxed segment divides completely the same loop if it be contracted hard.

The various wounds encountered include: (1) Clean perforations produced by bullets striking the intestine squarely; when at the free border one perforation is found, otherwise two. (2) Obliquely-striking missiles produce larger and ragged openings, or slits of various kinds and lengths with, or without, opposing perforations, or complete divisions of the bowel. (3) In extreme injuries, segments of bowel are completely torn away, and "a long, narrow, ragged strip of bowel" is left. (4) Combinations of many of all these forms are found in any one abdomen. Isolated lesions are the exception. The lesions are grouped together in a single area, or grouped together in several areas, or scattered more or less uniformly throughout. (5) Mesenteric wounds. These vary from contusions and hemorrhagic infiltrations to conditions in which shorter or longer lengths of bowel are torn from their mesenteric attachment.

The following is the usual practice in *repairing intestinal injuries*:

(1) Small round perforations are closed with a single purse-string suture. Silk or linen is usually employed for this purpose. Multiple small perforations at sufficient distances from one another are treated independently. (2) In ragged, long, slit-like wounds a running stitch is employed. The same method is more expeditious for a number of small perforations placed closely together. (3) In a simple complete division, with a fairly healthy mesenteric attachment and a sufficient blood supply, end-to-end anastomosis is best. This is done: (a) Most quickly and efficiently by a Murphy button; or (b) by the usual suture method (a single well-applied layer is said to be ample); or (c) by approximating the ends roughly by through-and-through sutures and guarding the anastomosis by wrapping it in several layers of omentum securely fastened in place. Usually, the blood supply at the edges is ample and the damage to the intestinal wall is not spread; this was shown in some studies of McNee and Dunn. (4) Resection is indicated when: (a) A length of bowel is damaged beyond hope of repair by suture; (b) when several complete divisions or severe injuries are close together; (c) when a length of bowel is deprived of its mesenteric attachment; or (d) when a part of the mesentery is hopelessly infarcted.

The *methods of anastomosis* employed include the following: (a) Closure of both ends and a side-to-side anastomosis in the usually approved manner; this method takes longer but it is said to be the safest; (b) closure of one end and an end-to-side anastomosis of the other, preferably by button; this is more quickly done and yields an equal security with the first; (c) end-to-end anastomosis by suture or button. A button operation can be done quickly, and, when properly made, yields an excellent result. In doing a suture operation, a single row of stitches is said to be sufficient.

Repair of any injury by suture is always preferred to resection, inasmuch as resection seems to give a higher mortality; multiple resection is practically always fatal. The figures, as given by Wallace, indicate a mortality of 54.6 per cent. for suture repairs, and a mortality of 76.9 per cent. for resections.

Short-circuiting operations or enterostomies, either at the primary or secondary operations, are not recommended. They are, however, done as occasions arise, and the indications for their performance follow along general surgical principles prevalent in civil life. A method was reviewed in last year's *PROGRESSIVE MEDICINE* not involving resection and available for injuries in which a length of bowel is deprived of its mesenteric attachment. The length denuded is surrounded by, and wrapped in, a double layer of omentum which is securely fastened in place; the mesentery is then re-attached by a few catgut sutures. In experimental operations, this method yielded an excellent result.

The *mortality* with small intestinal wounds increases with the presence and number of the complicating injuries. Wallace gives the results to be as follows: Small intestinal wounds alone gave a mortality of 65 per cent., and complicated small intestinal wounds, one of 74 per cent.

The causes of death in uncomplicated wounds are given by Wallace, as follows:

Cause of Death following	Resection.	Suture.
Peritonitis	14	14
Missed lesion	1	3
Shock and hemorrhage	15	11
Gas gangrene of belly wall	5	4
Asthenia	1	1
Paralytic ileus . . . . .	..	2
Pulmonary embolism . . . . .	..	2
Pneumonia . . . . .	..	1
Bronchitis . . . . .	..	2
Gangrene of lung . . . . .	..	1

A high mortality is associated with duodenal wounds (9 deaths in 11 cases), and with associated bladder and splenic wounds.

Wounds of the Large Intestine. The following table, taken from Wallace,¹ gives the general statistical information concerning these wounds. The total number of cases, of which these form a part, were 965.

Site of wound.	Wounded with stomach.	Wounded with small gut.	Alone.	Total.
Cecum	2	13	16	31
Ascending colon . . . . .	..	5	36	41
Hepatic flexure	1	7	24	32
Transverse colon	4	22	15	41
Splenic flexure . . . . .	..	3	18	21
Descending colon	2	9	17	28
Pelvic colon . . . . .	..	18	23	41
Position not stated	4	12	6	22
Totals	13	89	155	257

In the solid organs the figures given include the kidney 7 times, the liver 7 times, and the spleen 7 times.

In a general way, the character of the large intestinal injuries is very similar to those seen in the small intestine, and the lesions include per-

forations, slits, irregular tears, complete division, and infarctions. A preponderance of tears and perforations is found. Multiple injuries are found at the flexures and in the portions provided with a mesentery; aside from these situations the fixity of position is conducive to single injuries. Drummond and Dunn²³ describe injuries in which the missile ruptures the muscular coats and destroys the blood supply without real penetration. Very shortly—within a few hours—larger or smaller ulcerations appear in the mucosa; these probably account for certain unexplained fistulous formations which have appeared at subsequent times. Injuries of the large gut are sometimes caused by spicules of bone most frequently derived from comminuted fractures of the pelvis.

The wounds, owing to the anatomical relations, are: (a) Entirely intraperitoneal; (b) entirely extraperitoneal; or (c) both intraperitoneal and extraperitoneal. The broad areas in the fixed parts of the bowel, devoid of mesentery, are frequently the localities involved in the trauma and the loose retroperitoneal tissue is suffused with blood, or becomes the seat of extensive hematoma formations. Fecal contamination becomes a prolific cause for infection, and the conditions being ideal, large phlegmons form. The latter are very serious and dangerous complications, and prompt surgical intervention is found necessary in order to avert a fatal outcome. The difficulties are tremendously enhanced by the fact that during the operation, owing to the suffusion of blood, the perforation in the extraperitoneal part of the gut is very readily overlooked even with the most careful technic; and, in a certain number, only a bruising of the gut occurs, which in some way (*vide* reference to Drummond and Dunn above) destroys the blood supply and causes ulceration with secondary perforation. These retroperitoneal injuries are the most dangerous of all abdominal lesions, because of the occurrence of infection, and frequently the violent sepsis is sufficient to kill the wounded man within a comparatively few hours.

Whenever it is expected that the damage is limited to the loin, a transverse incision yields the best exposure, otherwise the usual vertical incision is preferred. The method of repair of the individual lesion depends upon: (a) The condition of the patient; (b) the location of the lesion; and (c) its size. The rule is to remedy the lesion by suture whenever possible; a colostomy is the method of second choice. Resection is practically never done.

Wounds of the transverse colon are the most easily repaired; next in order, those of the upper portion of the pelvic colon, the cecum, and the vertical colons. The flexures are the most difficult parts to deal with, the splenic flexure more so than the hepatic, both from the inherent difficulties and from the larger extent of intestine which must be mobilized. Drainage is practically always necessary; the rule is absolute in retroperitoneal injuries even with a proper suture; in intraperitoneal wounds the presence of retroperitoneal hematomata, and the possibility of their being some contusion or perforation of the extraperitoneal portion of the gut, make drainage nearly always advisable.

²³ British Journal of Surgery, 1917, 5.

It is always better to repair the injury by suture. A number of exceptions are, however, present to this rule. In the transverse colon it is sometimes quicker to make a colostomy, and the condition of the patient, or the frequent association with other injuries nearby, may make this procedure desirable. In the vertical portions of the colon the scant material left may make a proper repair impossible, and an immediate colostomy is necessary, even though it carries with it in these locations a high mortality from infection. In the splenic region an artificial anus is also frequently necessary. The possibilities of suture or colostomy are shown in the table (Wallace¹):

Site of lesion.	Sutured.	Artificial anus.	Total.
Cecum	13	3	16
Ascending colon	25	11	36
Hepatic flexure	16	8	24
Transverse colon	13	2	15
Splenic flexure	10	8	18
Descending colon	9	8	17
Pelvic colon	16	7	23
Position not stated . . . . .	..	6	6

The greatest single cause for the mortality is infection. Suture repair of vertical colon wounds gave a mortality of 50 per cent.; artificial anus in the same locality gave a mortality of 73.5 per cent. (Wallace). The general improvement in the mortality, caused by the assumption of the policy of immediate operation, amounts to 31 per cent. for small intestinal wounds, and 20 per cent. for large intestinal injuries (Wallace). The comparative mortalities for the different parts of the large intestine are given by Wallace as follows:

Site of lesion.	To base.	Died.
Cecum	8	7
Ascending colon	14	16
Hepatic flexure	8	11
Transverse colon	5	10
Splenic flexure	4	7
Descending colon	8	6
Pelvic colon	8	10

Wounds of the Rectum. Wounds of the rectum are caused in the following ways: (1) Missiles traversing the pelvic cavity in an antero-posterior direction, in a semivertical direction, or from side to side can injure the rectum in its intraperitoneal, its extraperitoneal, or in both its intra- and extraperitoneal portions; (2) wounds of the rectum are frequent complications of buttock wounds. The size of the entire wound corresponds with the size of the shell fragment causing it, and varies from those in which only one side of the rectum or anus is torn or opened up, to those in which large parts of, or the entire buttock, are carried away with large segments of the rectum; an enormous cloacal opening results. With both of these groups, fractures of the pelvis, the sacrum, and the coccyx are, of course, very frequent, and the extent of the bony damage may be considerable, in that a large segment of bone is carried away,

or there is much comminution and the wounds in the soft parts and rectum are aggravated by large fragments, or small spicules of bone which are driven in all directions and tear and lacerate the tissues. (3) The ulcerative lesions described by Drummond (*vide supra*).

The rectum was found wounded alone 17 times, and with the small intestine 4 times (Wallace).

The chief dangers of rectal injuries are found in: (a) Infection—phlegmonous inflammation in the presacral areolar tissues; gas gangrene in the buttock muscles; peritonitis—and (b) from associated lesions—small intestine and bladder.

The treatment of these wounds and injuries is concerned with the treatment of the wound in the pelvic ring and soft parts, and with the wound of the intestine.

The treatment of the extra-intestinal wound in the pelvis and buttock is carried out along general surgical principles. If the pelvic peritoneum has been opened it is advisable to close it off from the external wound by a layer of sutures. The bowel wound, whenever possible, is closed by suture; in those cases in which segments of it have been torn away, it is considered advisable to close off the lumen for a few days until adhesions have had time to form. Frequently a colostomy is necessary; for this purpose the artificial anus is formed best in the transverse colon, both for ease in postoperative care, and because of the simpler technic of the secondary closure if that prove necessary.

The wounds caused in the manner indicated in group 1 are most advantageously treated by laparotomy. In a number of these the exploration reveals no intraperitoneal damage; the incision is then closed and the injury is treated externally through the region of the wound.

The repair of any rectal wound is not accompanied with the certainty of result as regards leakage, which is characteristic of sutures in other parts of the intestine; and the postoperative course is almost invariably marked by fecal fistulæ which are sometimes difficult to care for properly and are always indescribably tedious in healing. Proper provision for this complication is always made at the operation; even wounds in the peritonealized portion of the rectum are always guarded by a drain.

The mortality is very large; of 21 cases of rectal wounds, 14 died (Wallace¹).

Combined rectal and bladder wounds are described subsequently.

Wounds of the Pancreas. Wounds involving the pancreas are very rarely seen on the operating table. This is so because of the contiguity of the organ to large arterial and venous trunks, any injury of which would be likely to cause an immediate fatality on the field.

Possibly many pancreatic wounds are missed in the large retroperitoneal hemorrhages of the general neighborhood of the gland. In one case a bullet was found imbedded in the tail of the pancreas. In three others associated injuries were found in the stomach, stomach and liver and stomach and spleen; all of these were fatal. The total number of wounds numbered 5 in 965 cases (Wallace¹). None of the pancreatic wounds has ever given distinctive symptoms, and the injuries were discovered during the course of the laparotomies.

Wounds of the Kidneys.²⁴ In 965 cases the kidney was injured 74 times, and in 37 of these the kidney was injured alone; in 2 cases both kidneys were injured simultaneously (Wallace¹). The actual wounds include "scores, furrows, cracks in the capsule, avulsion or pulping of the poles, hemisection, and almost complete disruption."

All of these can be classified as: (1) Loin wounds in the bottom of which a more or less destroyed or injured kidney is found. (2) Sub-parietal injuries or disorganization due to impact of a large fragment in the immediate vicinity of the organ. (3) Perforating projectile wounds. (4) Pedicle wounds including those in which only one of the component parts of the pedicle is torn, and those in which all the structures are divided and the organ lies loose in the loin.

The amount of the retroperitoneal or intraperitoneal hemorrhage varies with the size of the vessel injured; a considerable hematoma is usually present. The amount of shock is said by Wallace not to measure up to the degree seen in civil injuries of the kidney.

Symptomatically, there may be: (1) An abundant immediate hematuria. (2) A delayed or repeated hematuria. As a general rule, the initial hematuria clears up within a few days; it may, however, persist. (3) A primary or secondary urinary fistula. The extravasation of urine is usually not marked, and it is most apparent with pelvis wounds.

Rigidity with isolated kidney wounds is due to the hemorrhage, and is usually limited to the appropriate side of the abdomen. The dulness due to free intra-abdominal fluid is generally very easily made out in the flanks.

The *treatment of kidney wounds* can be summarized as follows: (1) In isolated kidney wounds with a moderate primary hemorrhage repose and a policy of watchful waiting are sufficient. (2) If the hematuria is severe and the general state of the patient is good, intervention is indicated. (3) The presence of associated injuries furnishes their own indications. Associated wounds are found in the stomach, small gut, colon, pancreas, liver and spleen. Operation is frequently undertaken to exclude associated injuries.

As a general rule, the approach to the kidney is made through the loin and the steps of the operation are carried out with sufficient care to minimize the chance of converting a retroperitoneal into an intraperitoneal wound. In the presence of other lesions, other incisions may be found expedient. The wound in the kidney is handled with the greatest conservatism, and ordinarily the procedure employed—packing, suture, etc.—depends upon the amount of active bleeding. Unless the damage is irreparable, only the involved kidney tissue is resected. (Bashford and Fullerton²⁴ have shown that the renal cells are destroyed only in the immediate vicinity of the wound or radiating fissures.) Infarctive lesions are frequent; or parts of the organ necrose because of the division of the nutrient vessel outside the capsule; partial resection may be necessary. Wounds of the pelvis of the kidney are sutured or repaired by plastic operations.

²⁴ Bulletins et Mémoires de la Société de Chirurgie de Paris, 1917, xliii, 971. Bashford and Fullerton: British Journal of Surgery, 1917, 4 and 5.

Nephrectomy is indicated for: (a) Complete disorganization; (b) irreparable laceration of extensive parts of the cortex; (c) multiple complete divisions of the organ; division of the pedicle.

Secondary hemorrhage is a fairly frequent complication and occurs most often in the second and third weeks. Gas infections of the retro-peritoneal tissues have been noted.

Repeated attacks of hematuria usually indicate the presence of a projectile imbedded in the kidney parenchyma. The missile is removed with the least possible injury to the kidney tissue. A traumatic urinary fistula usually indicates a deep and serious lesion; nephrectomy is, however, not undertaken immediately. In late operations the kidney is opened, curetted and drained, and the procedure is repeated, if necessary; the radical operation of nephrectomy is done only after these conservative measures fail.

Wallace's figures are quoted to show the results of treatment:

Operation.	To base.	Died.
Kidney explored (principal wound)	25	7
Nephrectomy (uncomplicated)	2	3
(spleen wounded)	3	
(liver wounded)	1	1
(bladder wounded) . . . . .	..	1
(colon wounded) . . . . .	..	1
and splenectomy	3	2
No operation indicated in 24 cases.		

The causes of death at the Front are shock and hemorrhage. Associated wounds of the liver and kidney form a dangerous condition. At the Base, secondary hemorrhage and sepsis are the chief causes for fatalities.

Wounds of the Ureter. Wounds of the ureter are found during the course of operation. Fullerton—quoted by Wallace¹—makes the statement that urinary fistulæ resulting from ureter wounds do well if left alone. Attempts are, however, always made, when a divided ureter is found, to restore its continuity by suture; and the procedure is relatively easy at the upper and lower limits of the canal, and at its middle portion when too great a loss of substance has not taken place. Under the last condition the establishment of an external fistula, or a nephrectomy, may be indicated. Drainage to the suture line is, of course, always employed.

Wounds of the Bladder. As a matter of prophylaxis, Cathelin²⁵ advises and emphasizes the importance of having the men on the firing line empty their bladders before making or withstanding an assault, or during heavy firing. The empty bladder is comparatively well protected by the bones of the pelvis.

In 965 cases the bladder was found injured 45 times, and among these, there were 25 cases of pure bladder injury (Wallace¹). The number which reach the base is, however, much smaller, and Fullerton²⁶ estimates the proportion as 1 to 3000 or 1 to 4000.

²⁵ Lyon Chirurgicale, 1918, xv, 109. Brin: Bulletins et Mémoires de la Société de Chirurgie de Paris, 1917, xliii, 1086.

²⁶ British Journal of Surgery, 1918.

Two-thirds of the wounds are associated with buttock wounds. The actual injuries include contusions with, or without, lodgment of the missile in the bladder wall, tears, slits, and perforations. The injuries are intraperitoneal or extraperitoneal, or both. The wounds may be caused or aggravated by spicules of bone from associated fractures of the pelvis. The missile frequently remains in the bladder. The complicating lesions are given by Fullerton as:

Bladder, pelvic bone and rectum	11 cases
Bladder, pelvic bone and small intestine	2 "
Bladder and pelvic bone	9 "
Bladder and rectum	8 "
Bladder and small intestine	4 "
Bladder and pelvic colon	1 "

In the scale of gravity, wounds of the bladder can be classified as follows: (1) Those in the anterior surface of the bladder under the cul-de-sac. (2) Intraperitoneal wounds. (3) Those involving the fundus or lower parts of the lateral walls, because direct treatment is difficult, and because they are often associated with rectal or osseous lesions which lead to a general infection. Wounds near the neck of the bladder frequently involve the prostate.

Bladder injury is looked for in all wounds of the buttock, sacrum, groin, thigh and suprapubic region. A valuable aid is the determination of the bullet track. The other symptoms include those of (a) hemorrhage and shock; (b) leakage of urine, which may be hidden as a urinary extravasation; (c) retention of urine; (d) pain, tenderness and rigidity, vomiting and fever.

Although there are some spontaneous recoveries, the treatment of bladder injuries is entirely surgical. Fullerton gives the following indications: (1) All foreign bodies of whatever kind should be removed from the bladder as soon as possible. (2) The wound in the bladder, if accessible, should be closed. (3) Careful attention should be given to the perivesical and perirectal cellular tissue. (4) The wound in the parietes should be treated along general principles and as thoroughly as the anatomical peculiarities of the affected region permit.

With a wound in the lower part of the bladder draining perfectly, there is no need for an immediate cystotomy unless fever and retention call for it.

For extraperitoneal injuries of the anterior wall high up, the wound is regularized and sutured whenever possible, and the bladder is drained through a permanent catheter. In the vicinity of the neck, suture is not tried; the practice is to do a suprapubic cystotomy as high up as is possible, and, after a few days, to introduce a permanent catheter around which healing takes place.

For intraperitoneal injuries, if at the apex or in the posterior surface, intervention consists in regularizing or resecting the edges, double layer suture with catgut and drainage of the bladder by permanent catheter. The rest of the peritoneal cavity is isolated by closing the Douglas sac with a row of sutures. Wounds of the fundus, being generally produced

by perineal projectiles, necessitate a lateral or transverse perineotomy so that a loose tamponade can be made in contact with the bladder.

The chief immediate complication is, of course, hemorrhage and infection of the peritoneum or pelvic cellular spaces. The sequelæ which have been noted include necrosis of bone, persistence of cystitis, calculus formation, stricture at the bladder neck, and kidney infection.

The *mortality* in uncomplicated cases is given by Wallace as 56 per cent. The chief causes for this are hemorrhage, pelvic cellulitis, peritonitis and gas infection.

Ricco²⁷ classifies the diagnostic signs of an endovesical projectile: (a) The point of entry of the missile and its probable track; (b) immediate total hematuria which persists to a less degree for three or four days; (c) cystitis and its accessory symptoms; (d) urinary retention; (e) metallic exploration for a foreign body; (f) bimanual palpation; (g) radiography; (h) cystoscopy. No single sign suffices and not every bullet which appears movable in the vesical field on radiography is necessarily in the bladder, unless other evidence is present of an intravesical body.

If a positive diagnosis is made, the method of extraction depends upon the kind of projectile. Small-arm bullets, which are smooth and regular in form can be extracted by the natural route using a Leueu lithotriptor. Urethrovvesical anesthesia suffices; at times, a complementary meatotomy at the moment of extraction suffices. This avoids sectioning of the bladder. In the cases of larger projectiles, or those of irregular form, or when covered with calculus formation, in fact, whenever its diameters are not conformable to the caliber of the urethra, suprapubic incision is indicated.

Combined Bladder and Rectal Wounds. In 45 cases of rectal wounds, Crosti²⁸ noted that in 14 cases the bladder was injured in addition, and in 2 cases the posterior urethra. More or less extravasation of urine always occurs. A combined fecal and urinary fistula follows, the healing of which is very tedious and prolonged. About one-third of these complicated cases result fatally.

The *treatment* aims to prevent urinary infiltration and stagnation with later infection through the rectal opening. In a very few—those without intraperitoneal involvement and with a large external opening draining freely—all that may be necessary is permanent catheter drainage of the bladder. In much the larger number, and as a general practice, it is better to side-track the flow of the excreta by a simultaneous cystotomy and colostomy. The usual practice is:

1. To open up widely the entire track of the projectile.
2. If there is any bony barrier in the way of free drainage, a transverse perineotomy is necessary.
3. A proximally placed colostomy. The advantage of making this in the transverse colon is pointed out by Fullerton.
4. In simple cases a permanent catheter; in the indicated cases a cystotomy high up with and without a permanent catheter.
5. Drainage of Douglas's pouch.

²⁷ Repert. de med. y cirurg., Bogota, 1917, viii, 200 (Abstr., Inter. Abst. Surg.).

²⁸ Riforma Medica, Naples, 1917, xxxiii, 604 (Abst., Inter. Abst. Surg.).

Big Abdomens in Soldiers. Pisani²⁹ reports that tonic spasm of the diaphragm during respiration, associated with segmental contraction of the oblique and transverse abdominal muscles, is causing a new variety of hysteric meteorism. Under chloroform the abdomen subsides to its usual outline; sometimes it subsides during sleep. In the 20 cases studied, other signs of hysteria were manifest.

Ceconi attempts to explain these extremely distended abdomens. In one type the trouble is caused by a hysteric, tonic spasm of the diaphragm. In the second type the meteorism is factitious, the men merely swallowing air to induce it. In the third type the meteorism is more in the flanks, and it occurs intermittently, reaching its height in twelve or sixteen hours and lasting for a few hours or days. Roentgenoscopy showed that the gas was mainly in the colon. The respiration in these cases was shallow, and this, with the pronounced bradycardia, suggested the interpretation that the symptoms were vagotonic phenomena.

The Effect of Gas Poisoning on the Alimentary Canal.—A number of investigators have described cases in which poisoning was followed by symptoms which strongly suggested gastric ulcerations. The report of Lafont and Roux mentioned last year has this year been substantiated by others. Ulcerations have also been noted in the esophagus and in the upper part of the intestine.

Moutier describes 6 cases in which, following the gassing, there were symptoms indicating that the appendix was involved. In half of the men there had been no previous symptoms referable to the appendix. The symptoms not being serious, the condition was permitted to subside without operation. Moutier does not indicate whether the symptoms were due to general toxic involvement or to a local action of the gas passing through the intestines.

CIVIL ABDOMINAL SURGERY.

General Operative Considerations. CARDIAC RISK IN OPERATIONS. Willius³⁰ finds it impossible to classify the cases, in so far as the risk of operation is centered in some cardiac lesion, on the basis of the valvular lesion alone because the true index of efficiency of the heart's function is the myocardium; and the effectiveness of the musculature varies in isolated cases of a fundamentally similar pathological condition. A classification based on the cardiac reserve is also impossible because no accurate means of determining this factor exists.

Willius distinguishes six groups: (a) Auricular fibrillation; (b) auricular flutter; (c) impaired auriculoventricular conduction (arborization block); (d) mitral stenosis; (e) aortic lesions, aortitis, dilatation and valve lesion. These are generally considered the worst risks if angina and aneurysm are excluded.

²⁹ Rivista Critica di Clinica Medica, Florence, 1917, xviii, 43. (Abst., Journal of the American Medical Association.)

³⁰ Transactions of the American Society of Anesthetists, Journal of the American Medical Association, 1918, lxxi, 64.

The best measure of the cardiac risk is made on the basis of a good clinical impression of the patient's ability to withstand strain, supplemented by a good history and a thorough physical examination. Pre-operative medical therapy and rest, combined with surgical and medical correlation after operation, are of paramount importance.

The best method of anesthesia is the open drop ether method. When skilfully given, it does not add any measurable hazard to the operating risk, even in thyrotoxic cardiopathies.

Pollak and Heffter³¹ found that the pre-operative index of the patient's cardiac strength was the pulse-pressure. It seems to make no difference, so far as the operative prognosis is concerned, whether the systolic blood-pressure is 105 or 160, so long as the diastolic pressure is not within 30 mm. of the systolic. In other words, provided the metabolism is near the normal, the pulse-pressure of the individual is the index of the cardiac strength, no matter what the systolic blood-pressure may be. The only exception to this statement is the very high pulse-pressure in aortic regurgitation.

Purgation of Patients before Operation.^{32 33} The experiments which were reviewed last year have convinced Alvarez that purgatives should not be given before operations because they bring about pathological conditions. The purgatives owe their effects to the fact that they are irritant poisons which must be removed quickly from the body, and act by interfering with intestinal absorption and by upsetting the balance of salts. The body is weakened and not strengthened. The disturbing features include loss of sleep; the increased difficulty of controlling mechanically the more liquid intestinal contents; the increased growth of bacteria; and a greater permeability of the mucous membrane leading to a more active absorption of toxins. The even flow of material from the stomach to the anus is rendered impossible; the consequence is a tendency to flatulence and distention. Purgation is followed by a period in which the bowel reacts so poorly to drugs that there may be grave difficulties in meeting a postoperative emergency. The complete emptying of the bowel makes the resumption of colonic activity much more difficult, inasmuch as the colon must be filled and distended to a certain extent before an evacuation can occur. The ether adds the finishing touches to what the purgative drug initiated. Alvarez suggests that food be given as late as possible before the operation; that even enemas be avoided if not absolutely necessary; that water and solid food be given by mouth as soon after the operation as possible; and that purgatives be avoided after operation as well as before.

Anesthetics. THE ACTIVITY OF LOCAL ANESTHETICS. The activity of local anesthetics on sensory nerve fibers was studied by Sollmann³⁴ by applying various drugs to the sciatic plexus and observing the presence or absence of reflex response to stimulation of the foot. On the human subject, the wheal method gives probably the nearest approach

³¹ Surgery, Gynecology and Obstetrics, 1918, xxvi, 3 and 312.

³² Ibid., 1918, xxvi, 651.

³³ Journal of the American Medical Association, 1918, lxxi, 878. Peet: Ibid., 1918, lxxi, 175.

³⁴ Journal of Pharmacology and Experimental Therapeutics, 1918, xi, 6, 79 and 887.

to the absolute anesthetic power. He found that cocaine, novocaine and tropacocaine hydrochloride and alypin are about equally efficient. Beta-eucaine is one-half, and quinine-urea-hydrochloride is one-fourth as active; apothesine, antipyrine and potassium chloride are one-eighth as active. Their efficiency ratio in comparison with cocaine is lower for sensory than for motor fibers. Alkalization increases the efficiency of the organic anesthetic from two to eight times, the increase being generally about one-half as much for sensory as for motor fibers. The addition of sodium bicarbonate to cocaine or novocaine does not increase the anesthetic activity. The addition of epinephrin prolongs the action very greatly, except with tropacocaine. The epinephrin does not, however, change the minimal efficient concentration. Mixtures of cocaine with novocaine hydrochloride or with quinine-urea hydrochloride give simple summation (sometimes somewhat deficient) without potentiation, just as with the motor fibers. Mixtures of the anesthetics with potassium sulphate give only simple summation. This would be of some advantage in reducing the required amount of the anesthetic, the conditions being more favorable in the skin than in the mucous membranes. However, too much should not be expected from the potassium mixtures. Apparently, therefore, the sensory fibers show some important differences from motor fibers in their response to local anesthetics.

BENZYL ALCOHOL AS A LOCAL ANESTHETIC. In laboratory experiments, Macht³⁵ showed that benzyl alcohol or phenmethylol possessed powerful local anesthetic properties on the one-hand, and a very low toxicity as compared with other well-known local anesthetics, on the other. A series of clinical cases in which weak solutions, 1 to 4 per cent., of phenmethylol were administered as local anesthetics for the performance of surgical operations proved that the drug is an efficient local anesthetic also in practical surgery. The low toxicity, the simple excretion of the drug by the organism, and the ease with which benzyl alcohol solutions can be sterilized, seem to give this drug certain advantages.

ETHER-OIL GENERAL ANESTHESIA BY WAY OF THE RECTUM. In Russia anesthesia by the rectal route has grown apparently in favor, and Kholtzoff³⁶ writes that he knows of over 1000 cases in which anesthesia has been induced by injection of ether and oil into the rectum. Four fatalities have been reported in Russian literature. He also mentions as serious complications that have been observed by Russian surgeons, a case of bronchorrhea, one of transient asphyxia during the operation, one of asphyxia three hours afterward, and postoperative jaundice in one case. The question as to the dosage appears to be still unsettled, but the experience to date seems to indicate that 0.9 gm. of ether to 0.9 pound of the patient's weight is the maximum dose. The ether and the oil should be equal in amounts. This estimation of the dosage according to body weight is more or less arbitrary; for example, a person with dropsy and one with obesity rightfully should have the weight of the

³⁵ Journal of Pharmacology and Experimental Therapeutics, 1918, xi, 288.

³⁶ Russkiy Vrach, Petrograd, 1917, xvi (Abst., Journal of the American Medical Association).

dropical fluid and of the excess of fat deducted before calculating the ether dose. Kholtzoff recommends this method of anesthesia particularly for operations on the kidneys, or when concomitant disease of the kidney is present; for operations on the head and face in which the mask interferes with the work; for exceptionally long and tedious operations; when the patient is much exhausted; or when there is reason to anticipate trouble from cardiovascular sources. He injects a small dose of some sedative subcutaneously an hour before the operation, and he thinks that to this he owes his success with smaller doses (0.7 gm. per 0.9 pound body weight) of the ether than others deemed necessary. The necessity for rinsing out the rectum at once at the close of the operation, of all of its ether-oil content, is emphasized.

Rectal anesthesia was proposed and tried out in America some nine or ten years ago, and several reports were published subsequently regarding this method of inducing narcosis. The technic never gained in favor with any appreciable number of American surgeons, mostly because there really was no need for this form of anesthesia, and to a less extent because there were subsequent symptoms of an unpleasant character which were avoidable under the ordinary usage. Then, too, about this time the technic of intratracheal anesthesia was perfected in America and proved to be far superior to the rectal method, and most nearly approached the common and accepted usage; and when, for one or another reason, such as the interference of the face mask with operative manipulations, another than the orthodox method was desirable, the intratracheal or intrapharyngeal method was sufficient and thoroughly efficient and extraordinarily satisfying to all concerned, because no new danger was apprehended or did ever come to pass.

Sterilization of the Skin. Bonney and Browning³⁷ recommend the following solution, which contains 1 per cent. of a mixture of equal parts of crystal violet and brilliant green dissolved in a mixture of equal parts of alcohol and water, for sterilizing the skin and other surfaces.

Six hours before operation the parts are painted with the solution; a compress of lint soaked in the same is laid over the area, covered by a protective, and held in place by a bandage or a binder. The compress is removed on the operating table and no further painting is done. The skin is stained an intense violet black and remains unchanged for a week or two. No irritation of the skin or of more sensitive parts, like the vulva and vagina, follows. Theoretically, it has two advantages: It is not irritating, and the antiseptic action continues for a long period. The clinical records are also in accord. Bacteriologically, "violet green" was much superior to iodine.

Palmyra Fiber, Suturing Material in Place of Silkworm Gut. The material is obtained from the fibrous netting that surrounds the bases of the leaves of the toddy palmyras growing luxuriantly on the West Indian Coast, especially Malabar. The fiber is easily obtained and can be had in all required sizes; it requires very little preparation before it is ready for use and is easily preserved; it is easily sterilized and keeps well;

³⁷ British Medical Journal, 1918, i, 562.

is fairly strong and sufficiently flexible; is phenomenally inexpensive and the supply is well-nigh inexhaustible. Strinivasamurti³⁸ strongly recommends the use of palmyra fiber in all cases in which silkworm gut is used.

Rubber Envelope Abdominal Pad. Bissell³⁹ has devised a pad made by enclosing four thicknesses of cotton towelling in a rubber envelope open at one end. The edges of the pad are sewed together, and a tape ten inches or more in length is doubled on itself and sewed to the middle of one border. The pad is kept in position in the envelope by passing the tape through one and the other openings in the free borders of the envelope. Although the pad is, in this manner, prevented from coming in contact with the intestines, the envelope is not completely closed, with the result that fluids from the abdomen can in part enter the envelope and be absorbed by the pad.

This rubber pad possesses advantages over all forms of gauze, in that it may remain in contact with the peritoneum, and under considerable pressure, for an indefinite time, without occasioning an appreciable injury.

The Blood-pressure as a Guide in Major Operations. Giddings⁴⁰ shows that frequent blood-pressure readings during anesthesia will do much to indicate the exact condition of the patient during an operation. Individual blood-pressures show a slight increase of 10 to 30 mm. Hg., due to excitement during the induction of the etherization, after which the pressure falls to near the individual's level. The individual level, after being reached, is maintained rather closely throughout anesthesia, barring changes due to oncoming shock, asphyxia, sudden cerebral anemia, or changes in the patient's position on the table. Certain other factors, such as struggling, depth of anesthesia, and manipulation of organs, also influence the pressure to a less degree.

In shock, the pressure falls, usually gradually, while the pulse-rate rises. In asphyxia, at the outset, the respiratory center is stimulated, the breathing is deepened, the vasomotor center in the medulla is thrown into action, and there is a marked rise of blood-pressure. This also applies to slighter degrees of deficient oxygenation. In cerebral anemia, the pressure phenomena are exactly reversed and the fall is abrupt, very alarming, and is accompanied by marked slowing of the pulse-rate. This phenomenon occurs most frequently in head operations in the semi-upright posture. Change of position to the horizontal, or the assumption of a slight Trendelenburg position, usually restores the pressure and the pulse-rate. The Trendelenburg posture is followed by an almost immediate drop in pressure, though not to an alarming extent, and a rather prompt return to the individual's level. The maintenance of this position for considerable lengths of time apparently produces no untoward results.

Postoperative Thrombosis and Embolism. Believing that the transfixion, or ligation of bloodvessels *en masse* favors the development of

³⁸ Indian Medical Gazette, Calcutta, 1917, lii, 444.

³⁹ Journal of the American Medical Association, 1918, lxx, 677.

⁴⁰ Transactions of the American Association of Anesthetists, Journal of the American Medical Association, 1918, lxxi, 65.

postoperative thrombosis and embolism, McCann⁴¹ has modified his technic in controlling hemorrhage by picking up vessels cleanly and ligating them without encompassing masses of tissue. The result in his own practice has been an elimination of postoperative embolism or thrombosis.

Changes in the Blood Constituents after Operation. Meleney⁴² states that in clean surgical cases undergoing operation, the white cells become increased to double their previous number in the first six hours after operation by an outpouring of polymorphonuclear cells. Thereafter the white cell count decreases rapidly in clean cases and reaches normal on the fourth day. Infection and contamination have nothing to do with the initial rise, but they tend to keep the count high. There is a trivial rise in the number of red cells after operation, but in the subsequent ten days this is followed by a progressive anemia, with an average loss of about one half million cells per cm.

Other things being equal, the count will be higher in those cases in which there are severe trauma to the tissues, many sutures and ligatures used, considerable loss of blood and long anesthesia, especially with ether. Normal types of individuals will produce a higher leukocytosis than abnormal types.

According to Dunn and Wynne,⁴³ the hemoglobin readings shortly after operation show very little change when compared with readings made before operation, even in cases of severe hemorrhage. The immediate postoperative reading often shows some increase over the preoperative reading. The lowest point of the hemoglobin curve is found usually from thirty to sixty hours after operation (a difference of less than 5 per cent. is not considered). The greatest drop in hemoglobin is usually during the first twenty-four to thirty-six hours, and is most rapid when salt solution infusions have been given. In the series showing only a slight loss of blood at operation, the hemoglobin readings are usually higher during the first twelve hours than those made before operation and there is very little postoperative decrease at any time.

Postoperative Pneumonia. Whipple⁴⁴ calls attention to the fact that postoperative pneumonia is a far more frequent complication than is generally acknowledged or reported. Its incidence in surgical services varies largely with the care given to its detection, and the lesion is frequently and carelessly overlooked under the term "postoperative reaction."

The most important predisposing factors are: (a) Recent or concurrent inflammation of some part of the upper respiratory tract; (b) pulmonary congestion; (c) inhibition of normal respiratory movements or excursions as a result of abdominal incision; (d) debilitated states; (e) increase of the numbers and virulence of the pneumococcus during the winter and early spring.

The pneumococcus, Type IV, is the organism most frequently found

⁴¹ British Medical Journal, 1918, i, 277.

⁴² Annals of Surgery, 1918, lxxvii, 129.

⁴³ Bulletin of the Johns Hopkins Hospital, 1918, xxix, 323.

⁴⁴ Surgery, Gynecology and Obstetrics, 1918, xxvi, 29.

in the patient's sputum. The pneumonitis caused by this organism is, as a rule, an atypical pneumonia, of short duration and resolves by lysis. It has a lower mortality than the pneumonias of Types I, II, or III, or the pyogenic or septic pneumonias.

The x-ray is a valuable aid in the early diagnosis of the complication. The lung shadow usually appears in the radiogram before frank signs of consolidations can be elicited.

Pulmonary complications occurring in the postoperative period have always been a source of much concern. After certain classes of operations—notably those in the upper half of the abdomen—the relatively high mortalities find their chief cause in the extraordinary frequency of pneumonic inflammations varying from a small lobular patch centered around some minor bronchus to a full-blown consolidation limited by the boundaries of one or several lobes. In a certain proportion the character of the clinical course gives every reason for the belief that the process is a reaction to bacterial trauma induced or precipitated by an impoverished general condition, resulting from the original undermining illness; and it is not unreasonable to interpret the complex as an intercurrent infection or disease interrupting the smoothness of the postoperative convalescence to which one is ordinarily accustomed.

In other patients the clinical course lacks the usual markings of a pneumonia of the lobar or lobular type, and the complicating condition owes its discovery to the assiduity with which daily examinations of the chest are made; a routine which frequently adds to the distress of the patient in the early postoperative days. The alleged carelessness is only seemingly so, since a large number give no perceptible physical signs and the evidence adduced, upon which the existence of the pulmonary condition is based, is entirely roentgenographic in character.

Pulmonary inflammations of this latter kind are manifestly not due to bacterial infection and the finding of diverse organisms in the sputum of these patients is in no way extraordinary. Pneumococci, streptococci and staphylococci are constantly harbored in the mouth and pharynx, and the demonstration of one or more of these organisms in the sputum does not necessarily contribute any importance to them as dominant etiological factors. In a few, the shape and location of the compromised lung tissue, the clinical course, and the characteristics and extent of the physical signs, indicate rather clearly that one is dealing with an embolic and infarctive process, and the supposition has been repeatedly proven true at postmortem examinations. It is quite possible that in a great majority of the pulmonary complications, the lesion is most properly conceived as one of embolic origin; and the fact that in many the complication is hidden, or overshadowed, or even undiscovered in the general clinical picture, is easily explicable by the relative insignificance of the size of the vessel blocked, by the comparative unimportance of the area of lung tissue deprived of its normal function, and by the absence of any bacterial toxemia.

To those of us who have had the opportunity of comparing the physical signs in the lungs during life, with postmortem findings, it is frequently disconcerting to discover normal tissues, when during life,

the physical signs—usually rales of one kind or another, sometimes with a greater or lesser degree of dulness—had led one to believe that a lesion must be present in the lungs. This most frequently occurs when there is much intestinal distention, and the physical signs are probably due to compression of the lung, or to change in the vascular equilibrium of the pulmonic circulation.

Glucose Intravenously as a Therapeutic Measure. "The supply of a suitable amount of hypertonic glucose solution administered intravenously has the following effect: The general appearance improves at once. The features are less pinched. The patient looks brighter and less 'toxic.' The respiration becomes slower and fuller. The blood-pressure rises. The pulse amplitude is markedly and persistently increased. . . . The tongue becomes moist. The patient asks for water and food. The kidneys and bowels become active. If the patient was restless or delirious, he becomes quiet and often goes to sleep while the injection is being given.

"Glucose is non-toxic, it is quickly utilized by the organism, it is the best sparer of nitrogen, it is a stimulant to the mechanism of cell metabolism, and it is easily prepared."

Litchfield⁴⁵ recommends the intravenous use of glucose both before and after operations, in desperate risks, to prepare the patient for operation; and for varied postoperative conditions in the therapy of which it offers particular advantages.

For clinical work, 250 c.c. of a 25 per cent. solution (of which the caloric value is conveniently counted as 1 calorie per c.c.) may be given in about one hour to the average adult patient. A pure water supply, filtered, doubly distilled and sterilized by autoclave, is desirable, and any pure glucose may be used.

THE ABDOMINAL WALL.

New Incision for Exposure of the Lower Abdomen and Pelvis. This incision was devised by Churchman⁴⁶ for facilitating the operative exposure of the organs in the upper and lower portions of the pelvis, especially the rectum, the ureter, and the bladder.

The technic of making the incision is well shown in the plates and is described as follows:

1. "SKIN INCISION (Fig. 21) begins at the symphysis pubis, runs in the mid-line upward for about two inches, then diagonally upward and outward toward the anterior superior spine. The point at which the longitudinal incision becomes oblique may be higher or lower, according as the chief exposure desired is the upper or lower part of the pelvis.

2. "FASCIAL INCISION (Fig. 21) repeats the direction of the skin incision, dividing the rectus sheath and dividing the fascia of M. oblique externus in the direction of its fibers and as high toward the anterior spine as desired. It is of great importance, in operating on the bladder,

⁴⁵ Journal of the American Medical Association, 1918, lxxi, 503.

⁴⁶ Annals of Surgery, 1918, lxxvii, 180.

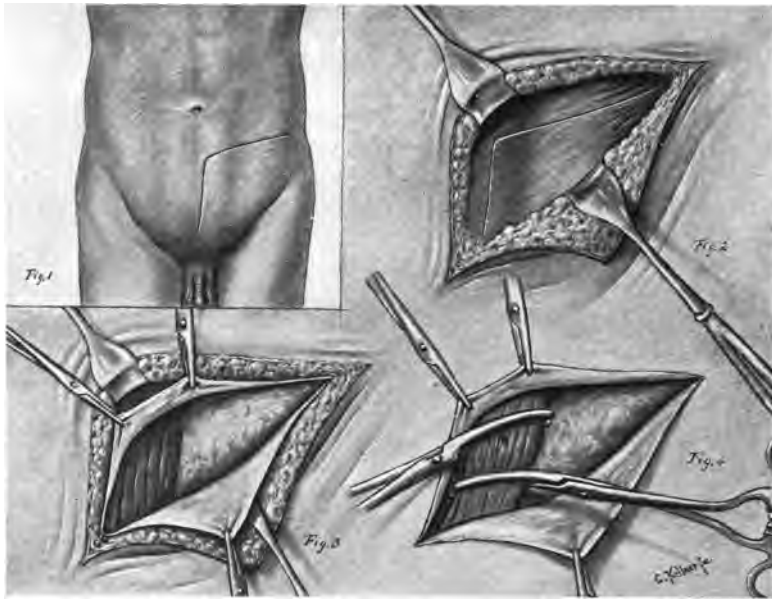


FIG. 21.—1, skin incision; 2, fascial incision (the horizontal arm should run exactly in the direction of the muscular fibers and not at slight variance with that direction, as shown in the illustration); 3, fascial incision; rectus exposed, after reflection of fascial flaps; 4, rectus grasped by clamps. (Churchman, *Annals of Surgery*.)

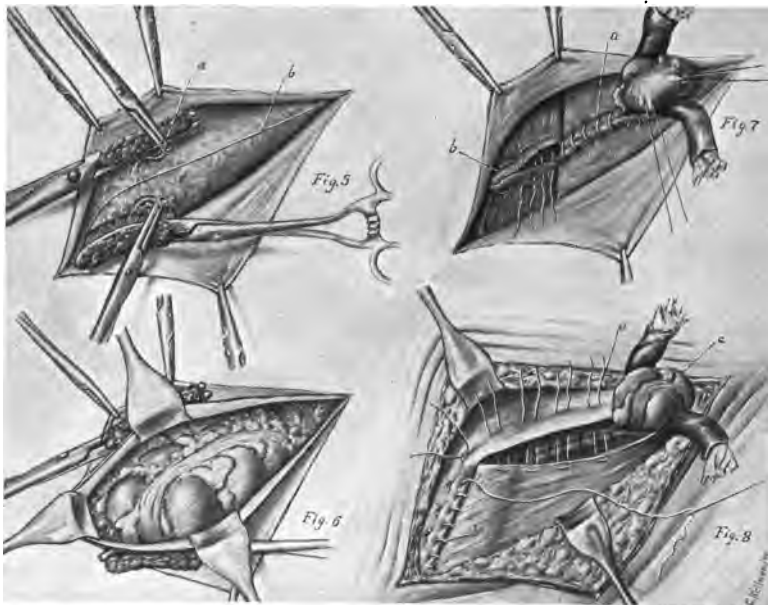


FIG. 22.—5, rectus divided: *a*, epigastric vessels ligated; *b*, incision in transversalis fascia and peritoneum; 6, exposure of peritoneal cavity; 7, beginning of closure: *a*, continuous stitch in peritoneum and transversalis fascia; *b*, mattress sutures in rectus; 8, closure continued: *a*, overlapping of anterior sheath and external oblique fascia by mattress sutures, and *b*, structure of free edge; *c*, bowel left out for colostomy. (Churchman, *Annals of Surgery*.)

that the anterior sheath of the rectus be divided down to the bone at the symphysis pubis.

3. "MUSCLE INCISION (Fig. 22). The rectus muscle thus exposed is freed and divided between clamps. Care is taken to push back the epigastric vessels from the posterior surface of the muscle; to clamp, divide and ligate them separately.

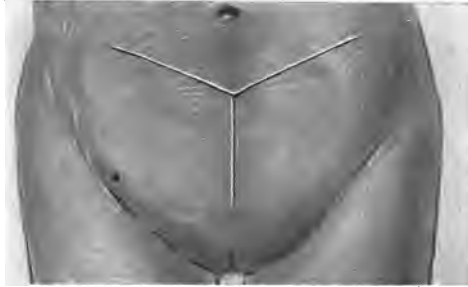


FIG. 23.—Bilateral incision in skin. (Churchman, *Annals of Surgery*.)

4. "The fascia of the M. transversalis and M. oblique internus and the peritoneum are divided by an incision which repeats the direction of the skin incision.



FIG. 24.—Both recti and pyramidalis divided; epigastric vessels ligated; Y-shaped incision in transversalis fascia and peritoneum. (Churchman, *Annals of Surgery*.)

5. "Exposure is thus obtained, practically without retraction. If exposure of the whole pelvis, rather than of only one side, is desired

the incision is made on the principles just described, but the oblique arms pass to *both* sides from the mid-line."

The closure of the wound is made as indicated in the figures. Muscle and fascial planes are united by mattress sutures and are overlapped as in any operation for the radical cure of hernia.

The Extreme Pendulous Abdomen and its Surgical Treatment. MacLean⁴⁷ describes a method of operative treatment for cases of extreme pendulous abdomen. The procedure is called a three-flap operation. Two long incisions forming an ellipse are made from one side of the abdomen to the other; the upper passing above the umbilicus, the lower passing about two inches above the fold where the abdomen hangs over the pubes. The skin and fat are dissected away from the external oblique aponeurosis until the ring of the umbilicus is met. The abdominal cavity is then opened at the umbilicus, and the mass dissected away from the umbilical ring. The part of the abdominal wall that has given way can be lifted up in the form of a cone, with the umbilicus forming the apex. Two lateral incisions are now made from the umbilical ring to the inner margins of the recti muscles. A third incision is made from the umbilical ring downward to the firm lower margin of the internal ring, where the recti muscles decussate. Three flaps are thus formed; two lower and one upper. The lower two flaps are overlapped from side-to-side, thus reducing by one-half the space between the recti muscles. The free margin of each flap is stitched with strong chromic catgut to the firm margin of the sheath of the opposite rectus muscle. The upper flap is drawn upward, and the upper margin of this lower and now double flap is stitched to the upper margin of the so-called internal ring. The upper flap is next drawn downward and spread over the lower double flap, and its margin stitched to the aponeurosis of the external oblique. The skin is closed, and three small drainage tubes are inserted, one at each angle and one in the center of the wound. In place of the relaxed wall, there is substituted a three-fold aponeurosis covering the opening, and secured at every point to normal anatomic structures that have not yielded to the intra-abdominal pressure.

THE ABDOMINAL CAVITY.

Abdominal Injury in the Newborn.⁴⁸ Injuries may occur with a spontaneous delivery. In 1000 cadavers of newborn infants, there were 2 cases of rupture of the liver, one with and one without spontaneous delivery. Another infant was found with rupture of the spleen; this, too, was a spontaneous delivery. There is one case each on record of rupture of the kidney and pancreas. Seventeen other cases of fatal injury of intestines have been found; one case of hematoma of the cecum, and two of rupture of omental vessels. In some, it seemed that the injuries occurred intrapartum before delivery. In others, organs were found, which, besides being engorged with blood, showed no change. In 8, of 1080 cases, hemorrhage was present in the suprarenals:

⁴⁷ Transactions of the Western Surgical Association, 1918.

⁴⁸ Svenska Lakaresallskapet Handlingar, Stockholm, 1918, xiv, 1.

Limitations of Operations on the Abdominal Aorta. Goodman⁴⁹ notes that the possibility of completely occluding the lumen of the aorta for a period of thirty minutes in animals, facilitates the carrying out of any procedure. Injuries of the abdominal aorta in dogs may be corrected with subsequent perfect restoration of the continuity of the vessel. While the reestablishment of the continuity of the severed aorta by the circular suture is possible, the approximation of the severed ends during the suture entails such injury that thrombosis frequently occurs. Therefore, when the aorta is completely severed, the introduction of a transplanted segment is indicated. In cases in which a portion of the aorta must be resected, an arterial segment taken from another animal can be safely used as a transplant. An arterial tube of increased caliber made of smaller vessels, such as the carotid, lends itself readily as a transplant to the severed aorta, with a reasonable assurance of reestablishing the continuity of the latter vessel. Defects in the aorta can be readily corrected by the use of fascial transplants with a minimum danger of thrombosis.

Ligation of the Abdominal Aorta. Hamann⁵⁰ describes a case in which ligation of the abdominal aorta, just above its bifurcation, was done for a pelvic tumor, which had been mistaken for an aneurysm. The patient survived for six months without developing gangrene of the extremities; death was due to hemorrhage from a bed-sore. The main points of interest in this case seem to be the following: (a) The fact that the patient lived six months after ligation of the abdominal aorta just above the bifurcation, without the appearance of gangrene of the extremities; (b) the partial restoration of the lumen of the vessel, after apparently complete obliteration by a firmly tied silk ligature; (c) the reappearance of the femoral pulse on the third day. Inasmuch as the aorta was found not to be completely obliterated, no proof is furnished that collateral circulation can develop after ligation of the aorta to a sufficient extent to prevent gangrene. Ligation of the aorta below the origin of the inferior mesenteric is a justifiable procedure for the cure of iliac aneurysm, and it affords fair chances for recovery and cure.

Occlusion of the Inferior Vena Cava. Up to 1911, only 43 cases of occlusion of the inferior vena cava, by extension from a hypernephroma, had been accurately described. In 13 of these, the growth reached as far as the right auricle or actually invaded it. In one instance the entire cava from iliacs to right auricle was filled with tumor tissue. Since then several other instances of obstruction, by intravascular new growth, have been reported. Jacobson and Goodpasture⁵¹ add another to the list. A renal hypernephroma extended from the kidney into the left renal vein, traversed the inferior vena cava below as far as the iliac bifurcation and grew upward into the right auricle and right ventricle, causing mechanical embarrassment to the tricuspid valve. The orifices of the hepatic veins had become plugged with tumor tissue, and had caused an acute central necrosis of the liver. The sudden enlargement of the liver was

⁴⁹ Journal of Experimental Medicine, 1918, xxvii, 573.

⁵⁰ Annals of Surgery, 1918, lxxviii, 217.

⁵¹ Archives of Internal Medicine, July, 1918, p. 86.

accompanied by the onset of an acidosis which persisted until the death of the patient twenty-four hours later.

Mesenteric Vascular Occlusion. Eisenberg and Shlink⁵² call attention to the fact that mesenteric vascular occlusion is not extremely rare, 400 cases having accumulated in the literature. The accident most frequently happens in the arteries, and the most common lesion which results is infarction of the intestines. The most frequent cause is embolism resulting from infection or trauma. The difficulties of making a correct preoperative diagnosis are emphasized by the knowledge that it was possible in only 13 of all of these cases.

Spontaneous Rupture of the Renal Artery. Lincoln⁵³ has gathered 15 cases of this rather uncommon lesion. An analysis of the cases brings forth the following facts: Two of the cases occurred in children and a third in a young adult; the others were all in older persons whose ages ranged from thirty-six to seventy-four years, with an average age of fifty-six years. Eight cases occurred in men and 5 in women (in 1 case the sex was not noted). Five of these patients were observed to have marked arteriosclerosis. The Wassermann reaction was made in only 1 case, in which it was negative. In no case was a history of syphilis elicited. One should, however, expect its presence in many of these cases. Three cases were supposed to have been caused by emboli. In 1 of these the patient was actually suffering from an ulcerative endocarditis. Four patients were definitely suffering from nephritis. In the remaining cases the etiology is assumed to be traumatic, inasmuch as, in a few, a history of some preceding injury was obtained.

A variety of conditions may grow out of a rupture of the renal artery. The simplest is a small sacciform aneurysm which remains intact and produces no appreciable change in the kidneys or in the surrounding parts. The aneurysm may occur anywhere in the main artery or in one of its branches, or even within the parenchyma of the kidneys. It varies in size from that of a hazelnut to that of an orange. Rupture of the aneurysm can take place into the renal pelvis and give rise to a hematuria, or into the peritoneal cavity, and cause death from hemorrhage. When a false aneurysm follows rupture of the renal artery, it may attain an enormous size. The blood may extravasate within the renal capsule, where it breaks down and disintegrates the parenchyma; or it spreads between the parenchyma and the capsule. The contents of the sac consists of clotted blood in different states of age, color and consistency.

A small sacciform aneurysm gives rise to no clinical symptoms. The symptoms of rupture are: (a) Acute and severe pain in the side, which may radiate to the genitals and give retraction of the testicles; (b) a certain amount of fulness of the flank, the amount of which depends upon the extent of the hemorrhage; (c) muscular rigidity over the flank, or over the appropriate half of the abdomen; (d) vomiting; (e) elevation of the pulse-rate. An extensive hemorrhage is accompanied by the evidences of considerable shock. A mass could be palpated, in 5 cases, varying in size from that of a grapefruit to that of a mass filling the whole

⁵² Surgery, Gynecology and Obstetrics, 1918, xxvii, 66.

⁵³ Journal of the American Medical Association, 1918, lxx, 80.

of one side of the abdomen. A bruit was not detected in any case, probably because it was not looked for. No marked tenderness is present unless there is localized peritonitis. Hematuria was present in 4 cases, and was profuse, except in 1 case in which there was only a trace. Dysuria and frequent micturition were noted in a few cases.

Clinically, aneurysms of the renal artery either give no symptoms during life, or give such indications of their presence as do not lead one to make the correct diagnosis. Some of the smaller true aneurysms may not directly bring about a fatal issue; but the larger false aneurysms cause symptoms which sooner or later give enough justification for operation, the usual diagnosis being that of tumor. The condition is susceptible of complete removal, usually with ablation of the kidney; but the technic is difficult, the risks of uncontrollable hemorrhage are very great, and the mortality is relatively high.

THE PERITONEUM.

Diversion of Ascitic Fluid. Toussaint⁵⁴ made a curved incision, the upper end 3 cm. above Poupart's ligament and the lower end 6 cm. below the junction of the internal saphenous vein with the femoral vein. The saphenous vein was then severed and carried up into the peritoneal cavity through a subcutaneous tunnel, hoping thus to drain the ascitic fluid into the blood stream. In a patient in whom this operation was done, the condition was immeasurably improved, although at first there was still much edema of the legs and lower trunk.

Tuberculous Peritonitis. Tuberculous peritonitis is not a primary disease; it functionates as a symptom and has its origin in local foci—the Fallopian tubes in women, some part of the intestinal tract in both men and women, and the lymphatic glands and channels in children. Occasionally, the primary focus will be found in the stomach, the spleen, the liver, the gall-bladder or the genito-urinary tract. In tuberculosis originating in the adnexa, tubal retention is uncommon, and tuberculous exudates pass out from the fimbriated extremity of the tube, which remains open, into the abdominal cavity, and cause a more or less generalized peritonitis. "Such peritonitis is essentially a conservative process leading to the destruction of the noxious agents," and when the source of the infection can be removed, the peritoneum returns to normal.

Rarely, in the experience of the Mayos,⁵⁵ has a tuberculous peritonitis originated in the appendix. The peritonitis which accompanies tuberculosis of the ileocecal junction is, as a rule, limited to the immediate vicinity of the primary focus, and the removal of the involved bowel promptly cures. This is equally true of localized tuberculosis of the small intestine.

A considerable number of cases of peritoneal tuberculosis, confined to the area above the transverse colon, were seen in which the lesion was particularly marked in the general region of the pylorus. In most of

⁵⁴ Gaceta de la Academia de Medicina, Mexico, 1917, No. 1, 6 (Abst., Journal American Medical Association).

⁵⁵ Journal of the American Medical Association, 1918, lxxi, 6.

these cases the gall-bladder was inflamed and was removed. Although such patients, without exception, have been cured, and Mayo questions whether such recovery might have taken place without the removal of the gall-bladder, no originating local tuberculous focus was ever demonstrated.

The lesions are of two varieties: An ascitic form, said to be due to a pure tuberculous infection, and an adhesive form, characterized by extensive adhesions and in a few cases by a variable number of pus pockets, in the contents of which pyogenic organisms belonging to the colon group have been demonstrated. The finding of the latter organisms has given the impression that the adhesions are due to a mixed infection. (Mayo.)

The ascitic forms are susceptible of cure by a simple laparotomy; the adhesive type of the disease is most favorable to spontaneous cure. The figures quoted by Mayo, Koenig, Shattuck, Wunderlich and Bircher indicate that surgical therapy is followed immediately by cure in approximately two-thirds of the cases; the number of cures, however, diminishes by half at the end of the first year after operation. At the end of three years the figures of Wunderlich show that only 26 per cent. of the cases traced were in good health. The mortality following medical treatment is 68 per cent. (Shattuck.)

The technic of the laparotomy, as practised by American surgeons, differs from that of their English confrères, in that drainage is always omitted because of the frequency with which the drainage tract persists indefinitely, oftentimes with fecal fistula formation.

Tuberculous Pelvic Peritonitis in Men. Duvergey⁵⁶ has encountered several cases of chronic partial occlusion of the bowel with enlargement of the abdomen, febrile periods, and loss of flesh. Ordinary palpation through the rectum revealed an encysted accumulation of fluid filling the small pelvis more or less completely. Compression from the ascitic fluid interfered with the function of the bowel and the bladder. The method of treatment included clearing out of the pelvis through a sub-umbilical laparotomy, and the insertion of a drain for five or six days. The 7 men who were thus treated seem to be cured completely; the postoperative intervals extending to two years. Duvergey warns not to attempt to operate through the rectum on the tumefaction there—the peritonitis should be given the benefit of the laparotomy. This pelvi-peritonitis is essentially a local and surgical form of tuberculosis.

Pneumococcus Peritonitis. Parker Syms⁵⁷ has contributed a fine review of the subject of pneumococcus peritonitis. It is a comparatively rare disease. In 104 pneumococcus infections in adults that were studied by Netter, no case of peritonitis was found; in 47 cases in children 1 case was found. In 140 cases of peritonitis which were bacteriologically examined by Netter, the pneumococcus was demonstrated twice. It is a disease particularly affecting children, more frequent among girls than among boys in the proportion of three to one. Up to the fifteenth year of age it is three times as prevalent as after that period.

⁵⁶ Paris Médicale, 1918, xxxii, 117.

⁵⁷ Annals of Surgery, 1918, lxxvii, 263.

It may occur (1) as the only manifestation; (2) as a sequel to some previous site of pneumococcus infection, *i. e.*, lungs, pleura, pericardium, ear, etc., or (3) as a part of a general blood infection in which other organs are simultaneously involved.

Clinically, several stages can be distinguished. The illness is ushered in by an extraordinary toxemia; the apparent overwhelming of the body by the poison makes it evident that the patient is much more ill than the abdominal symptoms would indicate. This merges very quickly into the second stage in which abdominal symptoms become pronounced—the signs of an advancing peritonitis. In the third stage a peritonitic effusion dominates the picture. During this period there is often an abatement of the active signs of toxemia. The temperature may fall and the patient seem decidedly less ill. The abdomen becomes distended, especially in its lower parts, and irregularly swollen, since one side is usually affected more than the other. In favorable cases the process shows a tendency to become encysted, and abscesses localize in different parts of the abdominal cavity. A peculiar characteristic of the disease in its late stages is the protrusion of the umbilicus, its final perforation, and the discharge of characteristic greenish-yellow sero-fibrinous, odorless pus. (The perforation at the umbilicus resulting from a tuberculous peritonitis is very apt to be a fecal fistula.)

The disease presents a clinical picture that should lead to diagnosis in most primary cases. Its characteristic signs are sudden onset, extreme toxemia, vomiting and diarrhea, very high temperature, and very high leukocytosis with a high polymorphonuclear count. There is a notable absence of local pain, local tenderness, and local rigidity compared with appendicitis or perforation peritonitis. Added to all this is the pneumonia aspect—cyanosis, slight dyspnea, and great depression.

A diffuse peritonitis and a localized encysted form of pneumococcus peritonitis are described. The diffuse peritonitis shows a tendency to remain diffuse and is characterized by extreme toxemia and marked constitutional disturbance; the encysted variety becomes localized early and exhibits a much milder clinical course. Opinions differ as to whether these are stages of one process, or as to these being two distinct varieties. The fact remains, however, that the diffuse peritonitis represents a period or condition of the utmost gravity, and is marked by a much higher mortality than the encysted form.

The general opinion seems to be that operation is not the proper form of treatment when the peritonitis is generalized and when the toxemia is severe. Under these circumstances, Syms advises the Murphy-Ochsner treatment for peritonitis. (If the abdomen is opened—and a laparotomy is frequently done under a mistaken diagnosis—a rapid bacteriological diagnosis is possible, by demonstrating in the smear, organisms with type pneumococcus capsules.) When the peritonitis is of the encysted form, or has become encysted, and when the extreme toxemia and depression are lacking, or have materially subsided, operation is undoubtedly the proper form of treatment. The localized collections of pus should be evacuated and the case should be treated according to the same surgical principles as would apply, in similar cases, to other varieties of peritonitis.

There is undoubtedly always a bacteremia; the peritonitis is really a local manifestation of a systemic infection or is a secondary focus to some other lesion, as a pneumonia. It should be possible to demonstrate the organism in the blood. The serum treatment should have the same place in pneumococcus peritonitis as it has in pneumococcus infections elsewhere. The reports which are available, however, indicate that, practically, it has no good effect.

Bile Peritonitis. Buchanan⁵⁸ speaks of a group of recorded cases of bile peritonitis in which, with an abundant effusion, no perforation of the biliary tract could be demonstrated at operation or autopsy. These cases can be explained in a variety of ways, some fitting one hypothesis and some another, no one theory suiting all cases. The bilious nature of the effusion still lacks the proof of a chemical examination. It is to be hoped that in subsequent cases the fluid exudate will be subjected to the test for bile acids and salts. The cases, being so unusual and so atypical, the diagnosis has never been made even tentatively. The treatment recommended by Buchanan includes dry mopping of the peritoneal cavity and direct drainage of the common duct.

The reviewer has operated upon a patient in whom the clinical evidences pointed to a subphrenic abscess. On aspiration, a bilious fluid was obtained; and upon free exploration a bilious effusion was found limited to the subphrenic space over the dome of the liver. It was not possible to demonstrate the source from which the bile came; the surface of the liver was covered with a thick shaggy membrane. The patient recovered.

Dévè⁵⁹ refers to a condition which he calls "choleperitoine hydatique," that is, a torpid effusion in the abdomen consecutive to the accumulation in the peritoneal cavity of non-virulent bile escaping from a ruptured echinococcus cyst of the liver. Multiple cysts should always be suspected and looked for, and the permeability of the bile passages should be verified before the conclusion of the operation. When an accumulation of bile in the peritoneal cavity has become encysted, it is dangerous and useless to attempt to remove it. It is important, however, to destroy any elements liable to start any new cysts; and Dévè relies on ether for this purpose, convinced that it has a specific destructive action on the scolices. Copious ether lavage of the peritoneum is thus advisable when a cyst has recently ruptured into it. Later than this, the granulations or vesicles showing inoculation of the peritoneum should be crushed by rubbing with a sponge and the site cauterized with 1 or 2 per cent. formaldehyde.

Dakin's Solution in the Normal Peritoneal Cavity. Mann and Crumley⁶⁰ describe the results of their experiments: The intraperitoneal injection of various amounts of Dakin's solution in the normal peritoneal cavity of dogs produces: (a) Decrease in blood-pressure; (b) pain; (c) marked serous exudate; (d) erosion and perforation of the omentum and mesentery, and (e) with rather large amounts, eventually death. The

⁵⁸ Surgery, Gynecology and Obstetrics, 1918, xxvi, 303.

⁵⁹ Revue de Chirurgie, 1918, xxxvii, 125.

⁶⁰ Journal of the American Medical Association, 1918, lxx, 841.

injection of Dakin's solution into the pleural cavity, in amounts too small to produce a mechanical action, is without noticeable effect. An amount of solution which is practically innocuous in either the pleural cavity or vascular system will produce quite marked effects when injected into the peritoneal cavity.

Observations are reported by Grey⁶¹ (185) in order to draw attention to the fact that the indiscriminate use of the chlorine antiseptics is not entirely devoid of danger. Both the neutral chlorinated soda (Dakin's solution) and dichloramin-T in chlorinated paraffin (chlorcosane, N. N. R., "Dakin's oil") when injected into the normal peritoneal cavity of a dog, leads to an inflammatory reaction, the degree of which is directly proportional to the amount of chlorine antiseptic used. With a sufficient quantity (less chlorcosane suffices) death ensues. When either of the chlorine antiseptics was injected into the gall-bladder of a dog no abnormal symptoms appeared. Following the injection of chlorcosane, however, the gall-bladder becomes thickened and shrunken, though the remainder of the biliary tract shows no discernible changes. A small amount of chlorcosane, when injected into the normal pleural cavity of an unanesthetized dog, may lead to a rapid (reflex ?) death.

Since chlorcosane, particularly, has been used without recognizable ill effects in certain infections of the abdominal cavity, the results from the experiments made by Grey suggest that the wall of an abscess cavity or sinus must play an important part in protecting the peritoneum in general from the effects of the free chlorine. They also suggest that the maintenance of an adequate drainage tract is an indispensable part of the technic for using antiseptics of this nature within the abdomen. Until more evidence is at hand, then, both of the chlorine antiseptics should be used in intra-abdominal infections with caution, and certainly only in carefully selected cases.

Contrary to other published opinions, Reimann and Magoun⁶² believe that the use of dichloramin-T in the peritoneal cavity, and in intra-abdominal abscesses, does not accomplish any good, and may do harm. On the other hand, Lee and Furniss⁶³ observe that this drug has proved of much value as a deodorant dressing, especially in wounds with fecal fistulæ.

Use of Ether in Peritonitis. Haines⁶⁴ has used ether intraperitoneally in all cases of peritonitis coming to operation. These include gastro-intestinal perforation from disease, gunfire and stab wounds; abortion, and leaking pus tubes; and tuberculous peritonitis. In a fair percentage of the cases, primary union was obtained throughout the line of incision, and the patients recovered without going through the process of sloughing of the abdominal wall, frequent dressings, prolonged stay in the hospital, postoperative hernia and morbidity so frequently encountered in this type of infection. In 66 cases in which ether was used in the manner indicated, the mortality was 10.4 per cent. Ether has been used

⁶¹ Bulletin of the Johns Hopkins Hospital, 1918, xx, 221.

⁶² Surgery, Gynecology and Obstetrics, 1918, xxvi, 616.

⁶³ Military Surgeon, 1918, xliii, 312.

⁶⁴ Transactions of the Western Surgical Association, 1918.

in military abdominal wounds, but indications are appearing that it is losing in favor.

Gastroptosis. Pauchet⁶⁵ emphasizes that gastroptosis must not be considered a purely local lesion, such as can be cured by an operation. There is always a complex pathological condition—insufficiency of the abdominal organs (liver, suprarenals, etc.); degeneration of the tissues; and an unstable nervous system. Persons with gastroptosis may have to be treated for months and years to correct each of the disturbances depending on these various causes, with liver and suprarenal organotherapy, physical culture, outdoor exercise, psychic reëducation, massage, and general hygiene. The therapy assumes the characteristics of an “abdominal orthopedics” and requires the coöperation of the surgeon, the physician, the masseur, and the physical culture trainer. Pauchet describes the operation which he has found most effectual in bringing the stomach and transverse colon into their proper place. He sutures the transverse colon to the lower margin of the stomach, and then draws up the stomach into the proper shape and size with half a dozen parallel threads quilted superficially the length of the anterior stomach wall, stopping short of the pyloric region and of the greater curvature. The threads are brought out through the skin and the field is painted with iodine to induce adhesion. In Pauchet’s experience with 30 operative cases, in 6 the operation alone failed to give permanent relief from all disturbances. They yielded only when “orthopedic” principles were applied. Then the patients gained in weight and the general condition improved.

The Falciform Ligament as an Adjunct Gastroptotic Support. Crouse⁶⁶ believes that surgical intervention in gastroptosis is only indicated in a small percentage of the cases that present themselves. Three technics have heretofore been devised and used, two of which, in Crouse’s opinion, have the glaring fault of neutralizing one of the chief aids in normal digestion, namely, the physiological synchronous movement of the stomach and diaphragm in respiration. These two operations are: (1) The basket support given the stomach and transverse colon by suturing the great omentum to the peritoneal surface of the anterior abdominal wall in a wide crescent, devised by Coffey; (2) Rovsing’s method of suspension on four sutures. The third, or Beyea’s operation, is the only one of the three that has the physiological qualities which digestion demands, namely, “it permits free movement of the stomach during respiration, thus increasing the gastric blood supply through the up-and-down pumping strokes of expiration and inspiration.” Beyea’s method of plicating the gastrohepatic omentum through a series of tucking sutures acts ideally, provided that thinning out of the omentum has not occurred to the degree that there remains insufficient material to serve as a supporting medium for the stomach.

Crouse has modified the Beyea technic as follows: The abdomen is opened through the right rectus muscle to avoid incising the peritoneal wing of the falciform ligament. The length of the incision

⁶⁵ *Presse Médicale*, Paris, 1918, xxvi, 189.

⁶⁶ *American Journal of Surgery*, 1918, xxxiii, 241.

extends from the ensiform cartilage to the umbilicus, thus giving ample room for attending to other coëxisting conditions. "The round ligament, its rounded substance standing out from its falciform peritoneal wing, is sought at the umbilical end, is then incised with curved scissors, then tagged with intestinal forceps. The peritoneal wing is strained upon to demonstrate to the fullest its abdominal wall attachment, and to the left of its attachment, a half to one inch or so, the peritoneum of the anterior abdominal wall is carefully detached along with the falciform ligament fold up to the latter's most 'superior abdominal wall area, and down to its umbilical end. The denuded area of the anterior abdominal wall is carefully tagged with intestinal forceps for future whipping occlusion. The falciform ligament is then, if its thickness permits, carefully split—the fold normally being in two layers—is next tagged, then covered with warm moist saline pads and laid upon the abdomen until the usual Beyea's technic has been carried out. Then the round ligament and falciform peritoneal wing—the latter split—is placed raw surface down so as to apply itself to the stomach and lesser omentum, being spread as far over as to include the lesser curvature area of the anterior stomach wall proper, as well as the plicated gastrohepatic omentum, to each of which it is tacked with twenty-day chromic No. 1 gut. The basting sutures used in fixing the ligament and its peritoneal fold to the plicated gastrohepatic omentum reinforce a weakened endothelial structure with endothelium material, plus ligamentary substance."

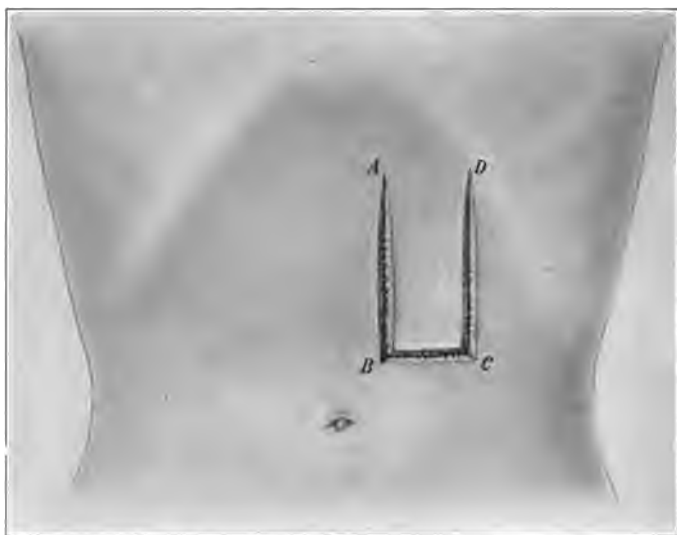


FIG. 25.—Gastrostomy. The cutaneous incision. (Stewart, *Annals of Surgery*.)

Permanent Gastrostomy. Stewart⁶⁷ has devised a new method for making a permanent gastrostomy. One makes an incision downward

⁶⁷ *Annals of Surgery*, 1918, lxviii, 194.

from a point just below and to the left of the ensiform cartilage parallel to the median line for 3 or 4 inches. About 2 or $2\frac{1}{2}$ inches to the left

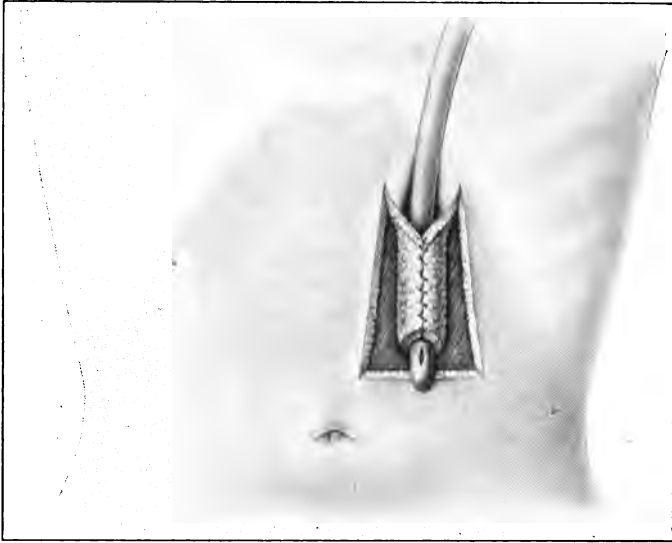


FIG. 26.—Formation of the dermal tube. (Stewart, *Annals of Surgery*.)

of this incision a second equally long cut is made on the same level, and the lower extremities of these incisions are connected by a transverse

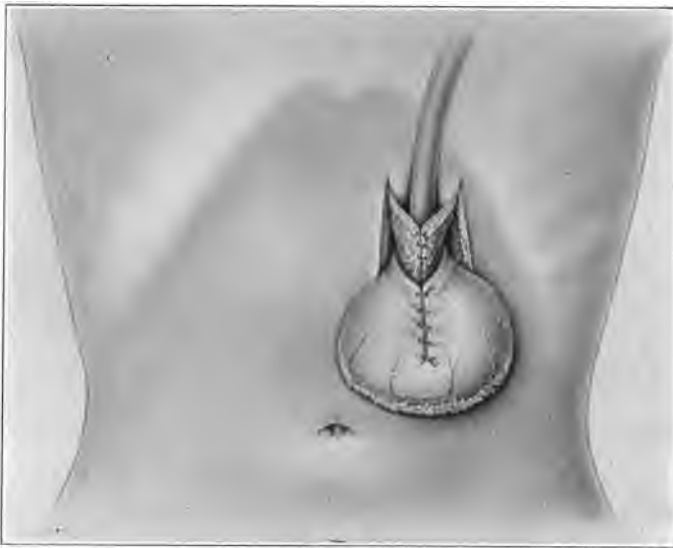


FIG. 27.—Envelopment of dermal tube by anterior gastric wall. (Stewart, *Annals of Surgery*.)

incision (Fig. 25). The rectangular cutaneous flap thus outlined is dissected free from the subjacent deep fascia as far as its base, and the two

long margins are sutured together with catgut over a catheter, the eye of which remains uncovered below the lower end of the flap (Fig. 26). The catheter with its enveloping skin is drawn to one side, the underlying rectus muscle is split longitudinally, and a portion of the anterior wall of the stomach drawn from the abdominal cavity. A small transverse opening is made in the exposed gastric wall, the inferior extremity of the catheter is pushed into the stomach through the opening, and the rim of the lower end of the cutaneous tube enveloping the catheter is sutured with catgut to the edges of the opening in the stomach (Fig. 27). The lower half of the dermal tube is buried in the wall of the stomach in the same manner in which the catheter is buried in the Witzel operation. The upper end of the canal thus formed by the inversion of the anterior wall of the stomach is sutured to the abdominal wall, and the

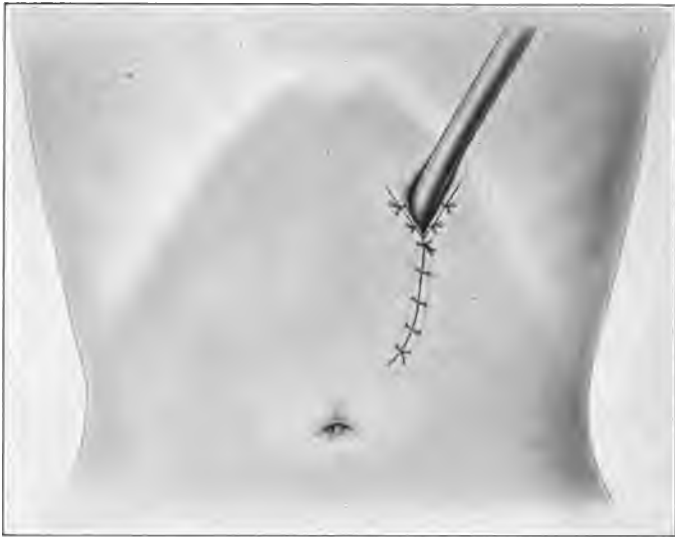


FIG. 28.—Cutaneous incision closed. (Stewart, *Annals of Surgery*.)

split rectus muscle approximated with catgut around the upper half of the cutaneous tube (Fig. 28). The skin about the raw surface which remains is undermined, and, beginning at the lower left corner of the oblong defect, is sutured, the sutures being inserted farther apart on the right than on the left, until the lower margin of the external orifice of the cutaneous tube is reached, when the suture line bifurcates to embrace the new stoma. The catheter is fastened to the skin with a catgut suture and should remain in place until the completion of healing; thereafter it is withdrawn, to be reinserted only at the time of feeding.

Gastric Ulcer. ETIOLOGY OF GASTRIC ULCER. In reviewing this subject last year it was pointed out that the efforts which had been expended along bacteriological lines in elucidating this problem had compelled the opinion that the superficial or deeper ulcerations, which it was possible to obtain by this method, were incidents in the course of a

temporary or perhaps fatal bacteremia, and were symptomatic of embolic phenomena. Corroboration of this view is found in some work of McMeans⁶⁸ which was recently published.

From personal observations and the evidence which he was able to gather from the literature, McMeans does not believe that lesions obtained in this manner represent the initial stage in the development of a gastric ulcer as it is observed in man. The finding of what appeared to be a spontaneous gastric ulcer in a rabbit supports this view, in that the experimental lesion and the spontaneous lesion were very dissimilar. Such lesions cannot justly be compared with the usual type of gastric ulcer observed in man, in that the strenuous methods employed exert a far more widespread influence on the tissues of animals than is ever found in humans suffering with gastric ulcer. They more nearly approach the appearance of the human gastric lesions which occur during the course of a general infection, and are but one of the several manifestations of such a disease. McMeans could not support the view of elective affinity expressed by Rosenow, because he had observed with equal frequency hemorrhage and erosions of the stomach of rabbits following the injection of various organisms obtained from indifferent sources.

Role of the Endocrine Organs in the Etiology of Gastric Ulcer. In the last two or three years attention has been called to the influence of disturbance of function in the endocrinous glands as a possible etiological factor in initiating gastric or duodenal ulcerations. The facts are as follows: Cioffi and Pende were the first to observe such lesions, and Gebelli was the first to pay special attention to them. Finzi,⁶⁹ in 1913, noted ulcerations which occurred after adrenalectomy, and he found it possible to prevent the occurrence of the lesions, after ablation of the glands, by administering adrenalin. Durante demonstrated that section of all three splanchnics on either side was followed by no change, while section of the median or minor nerve on either side was regularly followed by necrosis and ulceration of the gastric mucosa; on the right side prompt healing followed, on the left side changes in the spleen occurred in addition, and the ulcers showed a tendency to delayed healing. Elliot,⁷⁰ also, frequently noticed lesions in adrenalectomized cats, but adds that in Addison's disease no ulceration occurs. Mann⁷¹ made similar observations and adds that "ulcers seem to develop during the moribund period."

The results of Friedman's⁷² experiments, published in 1915, can be summed up as follows: Adrenal hypofunction causes lesions in the stomach in rabbits and in dogs. An excess of thyroid gland, as produced by repeated intravenous injections, was probably responsible for the gastric lesions of two dogs and of one rabbit (of four animals experimented upon). Thyroid hypofunction caused the appearance of

⁶⁸ Archives of Internal Medicine, July, 1918, 114.

⁶⁹ Virchow's Archiv, 1913, 214.

⁷⁰ American Journal of Physiology, 1915, xlix, 38.

⁷¹ Journal of Experimental Medicine, 1916, xxiii, 203.

⁷² Journal of Medical Research, 1915, xxxii, 2.

duodenal lesions in five animals out of six. An excess of adrenalin, produced by repeated injections of the drug, led to the appearance of lesions in the duodenum of dogs. The simultaneous production of adrenal and thyroid hypofunction did not lead to any lesions in the stomach, nor in the duodenum of rabbits. When, after removal of one adrenal, the other became hypertrophied, lesions were seen in both viscera of three rabbits and in the duodenum of one.

In dogs which had been thyroidectomized, Carlson and Jacobson⁷³ noted the frequency with which vomiting, diarrhea and anorexia followed the operation. At postmortem examinations there was marked hyperemia and congestion, and many hemorrhagic areas in the mucosa, with rather superficial ulcerations. In a number of the animals the pancreas was also injected.

Friedman's⁷⁴ latest studies resulted in the following conclusions: Thyroid insufficiency causes in dogs and in rabbits acute ulcers in the stomach and duodenum, and occasionally appendicular lesions. These macroscopic lesions did not correspond to those of chronic peptic ulcer. These ulcers do not show a tendency to heal, since permanent constitutional anomalies are probably created by the thyroidectomy. In man, minor degrees of thyroid insufficiency may cause the appearance of the initial lesion of peptic ulcer or of appendicitis. Since thyroid insufficiency is probably slighter in man than in animals in which the condition is produced experimentally, nature, assisted or unassisted by treatment, may overcome the anomalous conditions created by lack of thyroid secretion. The chronicity of ulcer is caused by other factors, among which may be mentioned the constant irritation of food upon the ulcerated region as the chief factor and the excessive secretion of hydrochloric acid. The primary lesion of appendicitis is not due to infection in all probability, but to thyroid insufficiency. After the initial lesion has been formed, the invasion of bacteria and stagnation of feces will help to develop the various forms of appendicitis. The diminished thyroid secretion in man may be responsible for the association of peptic ulcer and appendicitis. According to Friedman's work, similar gastric and duodenal lesions occur with equal frequency in rabbits and dogs after thyroidectomy. The coöperation of the adrenals or parathyroids in the causation of the initial lesion is probable. The probable existing relation between them must be a functional one.

It was quite to be expected that it should have occurred to some one to utilize all of these observations, and to construct of all of the obtainable facts a theory concerning the etiology of gastric ulcer; and the line of thought as presented by Friedman⁷⁵ is as follows: It is assumed that a "ductless gland neurosis" can appear, which in the course of time can lead to actual pathological changes, and which, directly or indirectly, causes secretory disturbances. In turn, a "gastric neurosis" is caused by these changes, and the evidences of the latter condition are found in atonic or spastic states of the stomach musculature. The spastic con-

⁷³ American Journal of Physiology, 1911; 1915, xxviii, 133.

⁷⁴ Journal of Medical Research, 1918, xxxiii, 69.

⁷⁵ Journal of the American Medical Association, 1918, lxxi, 1543.

dition is caused by deficiencies in parathyroid or epinephrin secretions, or by excesses of one or more of the thyroid products. The subtonic stomach is due to deficiencies in thyroid products or to excesses in parathyroid or epinephrin secretions. These opposing conditions of the gastric musculature cause vascular changes, such as ischemia or stasis, attributed to contraction or dilatation of limited areas of the musculature, either of the vessels themselves, or of the muscularis mucosæ surrounding the vessels. A consequent localized necrosis causes the original defect. In this way acute ulcers are formed. The conversion of these acute defects into unhealable lesions finds its mechanism in constant sources of irritation; of these, that produced by the continued and repeated introduction of food takes first place; the erosive effects of an excessive secretion of hydrochloric acid makes a very close second. In clinical observations Friedman has found, to his own satisfaction, instances which seem to corroborate this line of thought. In the discussion which followed the reading of his paper, Friedman went on to say that in his experiments he had never found a "chronic ulcer," but "ulcers without the tendency to heal in animals after parathyroidectomy". . . . "The absence of healing power in the experiments prove that constitutional anomalies can be roughly imitated in animals, and that the constitutional changes in man afflicted with ulcer prevent the ulcers from healing."

Some light was thrown on this phase of the question of the artificial production of gastric ulceration by Rehfuss⁷⁶ who detailed some experiments performed by Loeb and himself. They found that they could administer to animals the venom of *Heloderma suspectum* (a venomous lizard found in New Mexico) and produce an acute defect. Other substances, such as pilocarpine and atropine, which are supposed to act on the vagotonic system, hydrochloric acid, phenol, copper sulphate and bacterial toxins, were tried out, and it was found that every variety of substance produced an acute defect of the stomach wall which resembled a hemorrhagic lesion. The lesions which Rehfuss had seen in Rosenow's experiments were just the same sort as were produced with the previously mentioned toxic substances. At the Pasteur Institute in Paris, Rehfuss was able to show that it is possible to produce a form of ulceration with almost every toxic (bacterial) substance if one can get the animal into a sufficiently high state of toxicity. These experiences have convinced Rehfuss that there are forms of acute ulcer which are not specific.

In a small series of cases of Addison's disease which came to autopsy, Mann⁷⁷ found only one case in which there was a chronic ulcer. In this case there were also a small number of acute ulcers. In the formation of acute defects from ductless gland sources, Mann believes that one has two things: first, something in regard to the relationship of the anatomic mechanism of the gastric mucosa and its adjacent muscularis, together with some toxic factor which changes the condition of the cell, and promotes the digestion of the gastric mucosa.

A critical survey of the facts and theories of the ductless gland origin

⁷⁶ Journal of the American Medical Association, 1918, lxxi, 1543.

⁷⁷ Ibid.

of gastric ulcer cannot but result in the opinion that another method has been found, or devised, for creating in experimental animals acute defects in the wall of the stomach and duodenum. Just what the actual significance of these lesions are, in so far as they have a bearing on the etiology of human gastric ulcer, is not quite so clear, inasmuch as one must remember that experimental animals are not normally susceptible to the factors which cause ulcers in the human stomach (as proved by the records of zoölogical gardens); and the environment and manner of the experiment are of a nature fundamentally different from the probable processes in humans. One other disturbing factor noted, especially in some of the experiments, is that many of the ulcerations apparently occurred in the few hours immediately preceding death, in which period physiological and pathological artefacts are exceptionally common; one would ordinarily discard such observations altogether.

In looking back over one's experiences with gastric ulcer and with diseases of the ductless glands in their ordinary manifestations, one remembers that although on very rare occasions ulcer was clinically associated with evidences of ductless gland disturbance, usually an increased functional activity of the thyroid, and although in individuals dying of disease of some endocrine organ, the demonstration of gastric ulcer, postmortem, was very occasionally possible, that the concomitance appeared accidental and of no significance, and that between the component parts of the total clinical picture there was probably no relation of cause and effect. The fact that defects of some kind seem to follow forcible interference with normal endocrine functions is not extraordinary for similar defects can be regularly produced in so many other and different ways as to make it not unreasonable to suppose that there is a common factor in the mechanism of all of these different methods; and the nature of the agents—poisonous drugs, venoms, bacteria, chemicals and foreign bodies of various kinds, etc.—employed for the production of the defects, indicate only too clearly that these can be classed as chemical, or bacterial, or mechanical traumata. The secretions of the ductless glands are, also, autogenous biological poisonous bodies—of some of which a fairly definite chemical composition is known—and the toxic evidences of the latter are brought home to us in the manifestations of a fulminating thyroid intoxication, or of the slow, creeping, insidious Addison's disease.

The statement has been made that every chronic ulcer must have an acute beginning. Except for the cases of acutely perforating ulcers of the stomach or duodenum, in which a bacterial mechanism functionates, this statement is susceptible to much argument. For even with all of the various experimental methods of producing ulcer available to us, exact knowledge of the initial stages of human ulcer is wanting, and no proof can be offered in rebuttal to the statement that possibly, and even probably, at the present time an indeterminable number of chronic lesions have no acute beginning. In any case the trend of our knowledge is towards the assumption of the theory that defects, quickly forming or slowly forming, appear in the stomach because of more than one cause, and that the opposing forces in the gastric physiology are so accurately

balanced as to assure an extraordinarily rapid healing. In a number the healing is prevented—the term is used advisedly—by some factor which up to the present time has remained hidden. It is quite probable that this unknown factor may in itself be one of the agents capable of producing the original defect, in which case the continuance of its presence prevents the healing, or it may have become secondarily superimposed upon the original circumstance which had caused the primary lesion.

The activities of the ductless glands are many and widespread throughout the body and there is reason to believe that some, if not many or all, of the individual functions of gastric physiology are controlled by internal secretion either alone or in conjunction with nervous impulses. The physiological purpose is attained by the orderly working of all of these forces, and it is perfectly reasonable to assume that disturbances of the stomach functions, hyper- or hypo-acidity, or atony or hypermotility of the musculature—are concrete perceptible reflections of abnormalities in the endocrine organs. Such a theory explains many things in functional and organic disease of the stomach; it helps to clear up the etiology of the hyper-, the hypo- and the anacidities which have no apparent anatomical basis, and gives a cause for a primary atony or for a hitherto unexplainable hypermotility; and when an anatomical lesion, such as an ulcer, is demonstrable, it helps to make clear the mechanism whereby the organic lesion causes the accompanying disturbances in secretory or motor function.

SYPHILIS AS A FACTOR IN GASTRIC AND DUODENAL ULCER. Castex,⁷⁸ in reviewing the literature on gastric and duodenal ulcer, has been astonished to find how little reference is made to syphilis as a causal factor. It has been his experience that syphilis can be incriminated in the majority of cases in Argentina.

On the basis of personal observation, Castex and Mathis⁷⁹ believe that 90 per cent. of all ulcers occurring before the age of thirty are due to inherited syphilis, and the remaining 10 per cent. to acquired syphilis. After thirty, the proportions are reversed. Their opinion in one year's time has advanced from syphilis being a frequent, to its being the exclusive, cause. They believe the stigmata of syphilis to be more important in diagnosis than laboratory tests.

Castex described the clinical details of 8 cases in which the disturbance returned after operative treatment. There was great improvement in every case, but it was only temporary. In each case a history of inherited or acquired syphilis was elicited, often ignored by the patient, and the improvement or complete cure under specific treatment confirmed the etiological importance of this factor. Chronic suprarenal or thyroid insufficiency probably coöperates in certain cases with the syphilitic vascular lesion which, primarily, is responsible for the gastric or duodenal ulcer. Surgical treatment is indispensable for the various complications and mechanically facilitates healing, but it does not remove the cause.

⁷⁸ *Prensa Medica Argentina*, 1917, iv, 191 (Abst., *Journal of the American Medical Association*).

⁷⁹ *Ibid.*, 1918, iv, 495.

The ordinary medical treatment for gastric or duodenal ulcer is merely symptomatic, and is superfluous if the lesion is amenable to antisymphilitic measures. Conditions are the same here as in the brain and spinal cord lesions of tertiary syphilis. No treatment can restore irreparable lesions.

THE RELATION OF THE SYMPTOMATOLOGY OF ULCER TO THE ANATOMICAL LESION. Some fundamental facts were elicited by Wilensky⁸⁰ in studying the secretion of acid in ulcerative conditions, which have a bearing on the etiology of these lesions. Ulcerating lesions of the stomach or duodenum are not necessarily accompanied by disturbances of the acid secretion. The situation of the lesion bears no relation to the disturbance, when it exists, nor to its character or intensity. The disturbance in function bears no relation to the character and size of the defect present; nor to any complicating anatomical condition, such as a stenosis, which may coexist; nor to the time factor; nor to the character and intensity of the subjective symptoms. When the ante-operative facts were compared with those obtainable after operation, it was seen that a normal secretion followed most frequently operations for acutely perforating ulcers; that an ante-operative subacidity usually persisted after operation; that no rule could be formulated which could govern the sequence of events after operation in the hyperacidity cases; that in the last group, any change which occurred immediately, or shortly after operation, disappeared fairly rapidly, and a tendency was exhibited for the secretion to return to either the preoperative status, or to an exaggeration thereof.

This description of the facts describing the changes in an isolated function, both before and after operation, is given purposely, inasmuch as it serves exceedingly well to illustrate one of the troubles with which one has had to contend in the study of the etiology of gastric ulcer. The facts are based upon disturbances of physiological function; indicate that the latter have no proportional relation with the anatomical lesion present either in time, location, kind or character; they furnish a host of data, a seemingly hopeless chaos, out of which it is difficult, if not impossible, at the present time, to recognize, or to create, an orderly sequence between cause and result; or even to recognize accurately in which of the latter two groups any individual factor belongs.

The difficulties are immeasurably enhanced by the multiplicity of factors and functions which make up the total gastric physiological effort. Attempts have been made, time and again, to find in these functional disturbances the cause for the chronicity of ulcerating defects which, perhaps, have found their origin in any one of the numerous ways by which, experimentally, defects can be made. It is much more reasonable, however, to assume that the anatomical lesion has caused alterations in physiological function and there is much experimental evidence to corroborate and substantiate this latter view. It is not so easy to comprehend why there should be such variance in the quantitative relation between anatomical lesion and physiological function;

⁸⁰ Surgery, Gynecology and Obstetrics, 1918, xxvi, 506.

why an extremely large lesion should on occasion be tolerated for long periods with a minimum of discomfort; why a relatively small ulcer should occasion such profound disturbances in the various functions, and such consequent distressing symptoms.

It is difficult to understand in any individual case the relation of the postoperative clinical facts to the laboratory examinations, for it is found that subjective cures may be obtained when the laboratory examinations indicate a disturbed physiology, and postoperative symptoms may appear when the disturbance of secretion seems to be improving or when the secretion is within normal limits. This is probably due to the following facts: 1. The symptoms need not necessarily be due to the disturbance of acid secretion but to the disturbance of some other function of the stomach. 2. The symptom may be pain which is due to an ulcer which has not yet undergone healing or perhaps to some entirely different lesion. 3. The ante-operative suffering may have been so marked that the relief obtained by operation overshadows completely any slight subjective complaint which may persist or appear.

IMMEDIATE JEJUNAL FEEDING AFTER GASTRO-ENTEROSTOMY. Andresen⁸¹ has found that it is practicable, at the time of operation, to insert a previously swallowed Rehfuß gastro-duodenal tube well into the jejunum, and to commence at once the feeding of peptonized milk, dextrose and alcohol mixtures. Andresen considers that he has demonstrated that immediate jejunal feeding after gastro-enterostomy is not only safe, but an extremely valuable procedure, and is to be recommended not only in the operations performed for stenosis, but in all types of cases, as being more certain, and, in most cases, a less uncomfortable method of postoperative administration of fluid nourishment than the methods ordinarily employed.

LATE RESULTS OF GASTRO-ENTEROSTOMY. Udaonda⁸² reports the remote results following operation in 22 out of 71 cases of simple, uncomplicated gastric ulcer followed for from one to four years. Only 27.24 per cent. are free from stomach disturbances. All the others have had the old subjective symptoms return, as severe as before and as equally rebellious to treatment. The symptoms returned after intervals ranging from three months to two years; the average between the sixth and tenth month. The gastro-enterostomy opening seems to be working perfectly in all. Only in one case is there a suspicion of syphilis, and there is nothing to suggest ulceration in any case. In his non-operative cases, fully as good results were obtained with medical treatment alone.

Among the bad results of gastro-enterostomy in the 100 cases analyzed by Lippman⁸³ were: 3 cases of recurrent ulcer, 11 patients with post-operative adhesions, and 3 patients in whom the stoma remained too large or too relaxed. These latter patients suffered from gas and distention immediately after eating. There were 29 cases with poor after-

⁸¹ *Annals of Surgery*, 1918, lxvii, 565.

⁸² *Revista de la Asociacion Medica Argentina*, 1918, xxix, 5 (Abst., *Journal of the American Medical Association*).

⁸³ Quoted by Mayo: *Journal of the American Medical Association*, 1918, lxx, 1361.

results, 8 fatal cases, 12 cases which could not be followed in this series, and 51 cases with good results. Among the good results are 12 cases of pylorostenosis which, separated out, only give 39 cases of chronic ulcer with good results.

Gastroduodenostomy. Balfour⁸⁴ points out how important it is to become familiar with the indications for, and the various methods of surgical therapy, for gastric ulcer, because such complete knowledge avoids the error of forcing a favored operation in unsuitable conditions. Gastroduodenostomy is indicated for a lesion involving the pylorus, associated with marked obstruction, and with more or less ballooning of the duodenum producing a deformity which is the counterpart of an hour-glass stomach, especially if such a lesion is active or has caused the pylorus to become fixed to the pancreas, or liver, or in a mass of adhesions, and it is complicated by anatomical derangements of a nature to preclude or make inadvisable a posterior gastrojejunostomy. In the instances in which patients have failed to obtain the expected relief from gastrojejunostomy because of secondary complications, such as gastrojejunal ulcer and mechanical difficulties, or because of unknown reasons, gastroduodenostomy has given good results when it followed the cutting off of the old anastomosis and the restoration of the walls of the stomach and jejunum. "It should be mentioned that the lesion in these various conditions, as far as can be determined, is a chronic ulcer, that it is not safely excisable and that conditions are such that a pylorectomy is not justified because of the operative risk." The operation under good circumstances is more easily and quickly done than a posterior gastrojejunostomy. In other cases, however (usually when the operation is not one of choice), exposure is difficult on account of the deeply placed and fixed pylorus, but even in these unfavorable cases, the results of the operation and its adaptability to specific conditions have been exceedingly satisfactory.

Hour-glass Stomach. Downes⁸⁵ describes the results of operation in 17 cases of hour-glass stomach due to benign stricture. In the majority of the cases 4 operative procedures are available: Gastro-enterostomy, gastropasty, gastro-gastrostomy, and mediogastric resection in continuity. (If the lesion is sufficiently close to the pylorus a fifth method is available, pylorectomy or partial gastrectomy with the necessary gastro-enterostomy.) The roentgenograms taken at considerable periods of time after operation demonstrate very clearly that the various methods employed have met the prime indication, that is, they have overcome the obstruction. Whether the results obtained will be permanent in every case remains to be seen, but some of the cases have been followed sufficiently long to warrant the claim that a cure has been effected. From a study of the clinical results, Downes came to the conclusion that each of the four operative procedures gives equally good results provided the correct one is applied in a given case, and is executed in a proper manner.

⁸⁴ *Annals of Surgery*, 1918, lxvii, 80.

⁸⁵ *Surgery, Gynecology and Obstetrics*, 1918, xxvi, 1.

Carcinoma of Stomach. ETIOLOGICAL RELATION OF BENIGN ULCER TO CARCINOMA OF THE STOMACH. Latterly, the relationship between ulcer and carcinoma of the stomach has received much attention and the belief has gained ground that carcinomatous transformation of a benign ulcer takes place frequently. The morphological criteria described by Stromeyer for making such a judgment include a defect in which the base is entirely free of tumor, and of which the periphery shows only at one, or at several points, atypical carcinomatous forms. Wilensky and Thalhimer⁸⁶ point out that in any given case the opinion is subject to the following limitations: That the observation gives no inkling as to the age of the lesion, its preceding condition, or its terminal outcome if it had been left undisturbed; normal growth, hyperplasia, and malignancy make use of the same fundamental laws of growth, and, of necessity instances must occur in which a differentiation becomes difficult; the amount of necrosis which occurs in malignant tumors. The importance of the last factor is apparent on referring to the accompanying diagrams.

In Fig. 36 the amount of necrosis is minimal. A more extensive necrosis results in (a) Fig. 37, in which only the base is free of tumor; (b) Fig. 38, in which part of the base and periphery are carcinomatous; (c) parts of the periphery only are carcinomatous, either at one point (Fig. 39), or at more than one point (Fig. 40), equally or unequally. In Fig. 41 almost a maximum amount of necrosis occurs, leaving a base entirely free and a periphery with small areas of definite tumor tissue, or in which there may be difficulty in differentiating hyperplasia from malignancy.

The difficulty of differentiation occurs especially with the specimens in the last group for an identical microscopic picture results both (a) when a tumor undergoes an almost maximum necrosis, and (b) when a benign ulcer undergoes carcinomatous transformation at one point. Only with lesions of this kind is it ever possible to say, with any degree of certainty, that carcinoma has become implanted on an ulcer, and the proportion, as given by Wilensky and Thalhimer, and by Ewing,⁸⁷ is 2 and 5 per cent. respectively. These figures agree with those published in Europe before the war. Because of these facts and other supporting evidence, Wilensky and Thalhimer question whether the large indurated and crateriform ulcers, which occur on the lesser curvature and posterior stomach wall, are not originally tumors which have undergone this almost maximum necrosis.

One finding is significant, namely, that in a large number the gross appearances of the lesion resembles that of a benign defect; and the lesson is obvious that all of these lesions must be considered as potential carcinomata until the microscope discloses their true nature.

EXTENT OF TISSUE TO BE EXCISED FOR A RADICAL REMOVAL OF CARCINOMA OF THE STOMACH. An investigation was made by Thalhimer and Wilensky⁸⁸ for the purpose of determining the minimum amount of tissue adjacent to small carcinomata of the stomach wall

⁸⁶ *Annals of Surgery*, 1918, lxvii, 215.

⁸⁷ *Ibid.*, 1918, lxvii, 715.

⁸⁸ *Ibid.*, 1917, lxvi, 421.

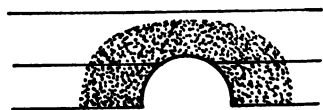


FIG. 29

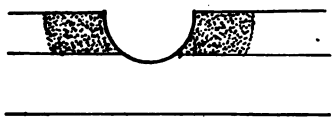
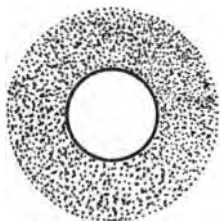


FIG. 30

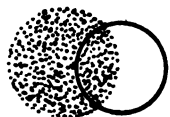


FIG. 31

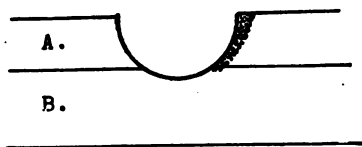
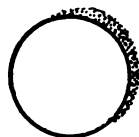


FIG. 32

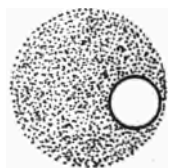
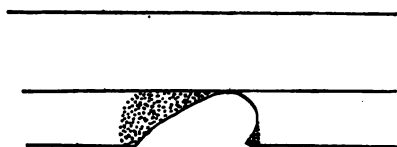


FIG. 33

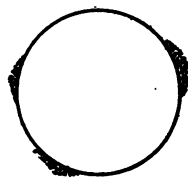
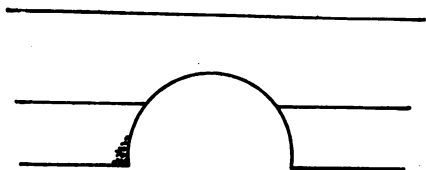


FIG. 34

FIGS. 29 to 34.—Diagrammatic representation of the possible relationship of a defect to a carcinomatous lesion to the stomach wall. A full view and a cross-section are given in each figure. The dotted areas represent carcinoma. The segments of the circles represent the relative position of the defect. (Wilensky and Thalhimier, *Annals of Surgery*.)

which must be resected in order to secure a complete operative removal of the malignant process in those cases in which the regional lymph nodes apparently are not involved and in which there are no demonstrable

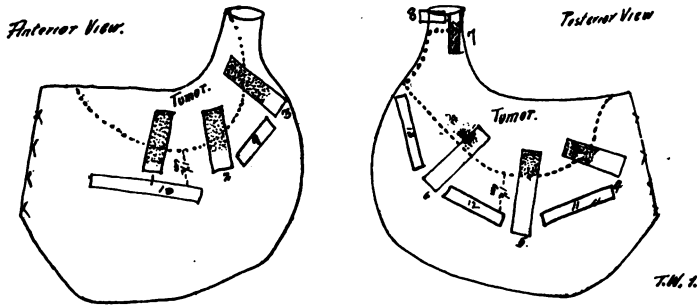


FIG. 35.—(Thalhimer and Wilensky.)

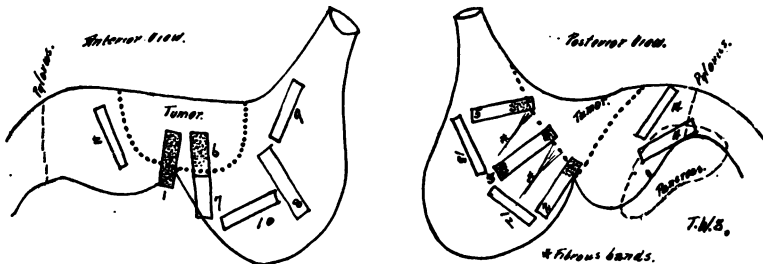


FIG. 36.—(Thalhimer and Wilensky.)

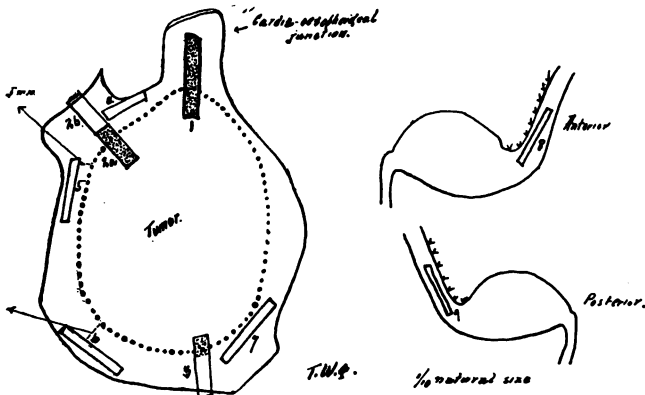


FIG. 37.—The specimen is a carcinoma at the cardia. The figure to the right shows the part excised laid out flat; that to the left shows the rest of the stomach, secured postmortem, and the line of sutures indicates where the tumor-bearing area was excised. (Thalhimer and Wilensky.)

metastases. The accompanying diagrams are self-explanatory, and show the manner in which the study was made. The extent of the malignant involvement is indicated by dotted areas.

From the evidence submitted, it seemed justifiable to conclude that in small carcinomata of the stomach, situated elsewhere than at the pylorus, the malignant process is so limited in extent that local resection at a distance from 1 to 2 cm. beyond the macroscopic limits of the tumor will in the majority of instances remove the entire tumor. Even

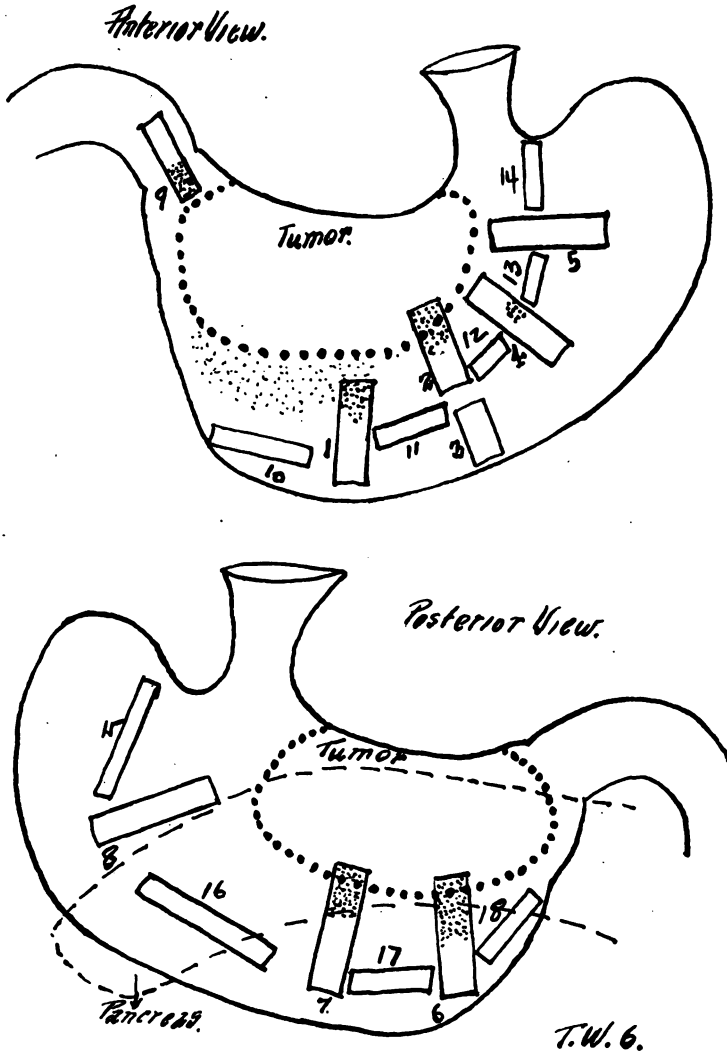


FIG. 38.—(Thalhimer and Wilensky.)

in some of the comparatively large tumors included in the study there was no extension of the tumor detectable by the microscope beyond this limit.

The clinical significance of these investigations is twofold:

1. Inasmuch as the surgeon frequently makes a local excision of an

ulcer in the belief that the latter is benign in character, these investigations show that such a local excision is sufficient for a radical removal

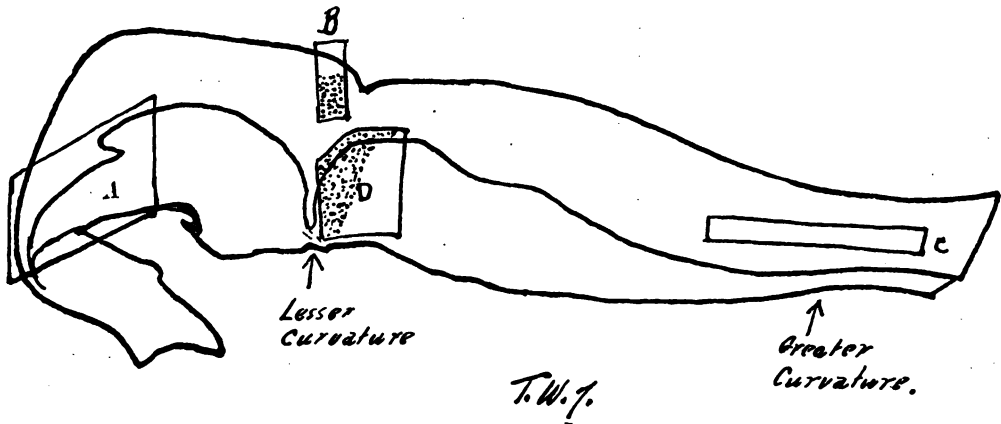


FIG. 39.—The specimen resulted from a mesogastric resection. The lesion, very ulcer-like in its gross appearance, straddled the lesser curvature. Numerous other blocks, besides those shown in the diagram, were cut during the course of another investigation; no tumor tissue beyond that indicated was found. (Thalhimer and Wilensky.)

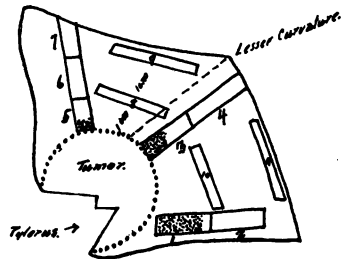


FIG. 40.—(Thalhimer and Wilensky.)

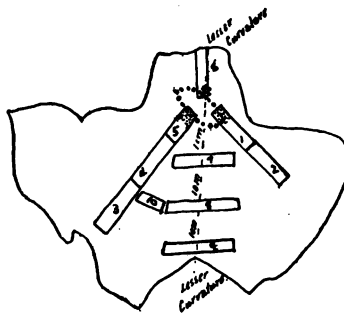
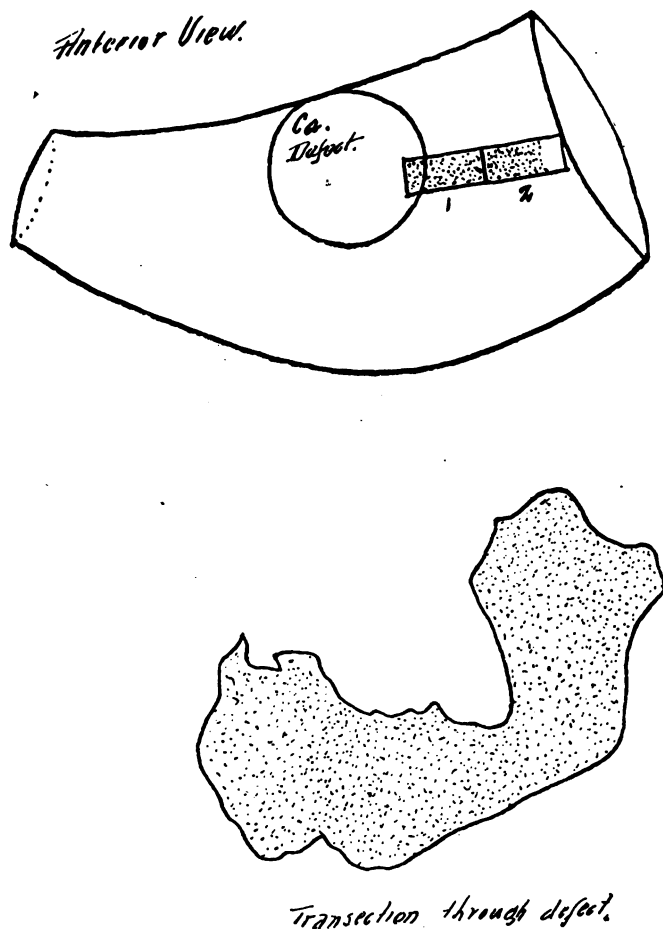


FIG. 41.—(Thalhimer and Wilensky.)

of the malignant process even if subsequent pathological examination shows the ulcer to have been carcinomatous in character. Of course,

such a local excision would be radical only when metastatic glandular involvement is not present.

2. When a malignant tumor is situated at the cardiac end of the stomach, at present the surgeon may either do a complete gastrectomy



T.W.G.

FIG. 42.—This specimen should be considered in the nature of a control because of the extensive involvement. (Thalhimer and Wilensky.)

or consider these cases inoperable. The serious consideration of complete gastrectomy is almost forbidden in these cases because of the high mortality of this operation. Local excision of the tumor is a far less dangerous procedure, and, since the above investigations have shown

that such local excision is sufficient for the removal of the malignant process, these tumors become accessible for radical operative treatment. Of course, such excision is only radical when no metastases are present.

LATE RESULTS OF CANCER OF THE STOMACH. Some late results of operation for gastric cancer are detailed by W. J. Mayo.⁸⁹ During a period of twenty years, 651 resections of the stomach for cancer were done at the Mayo Clinic. Of 427 patients operated on more than three years ago who recovered from the operation, 311 have been traced; 120 (38.6 per cent.) were alive three years or more after the operation. Of 313 patients who were operated on more than five years ago, 239 who recovered from the operation were traced, and 62 (26 per cent.) of these were alive five years or more after operation. No special effort was made to trace patients after the five-year period, but incidentally it was learned that 35 lived six years or more after operation, 27 lived seven years or more, 18 lived eight years or more, 10 lived nine years or more, 7 lived ten years or more, 5 lived eleven years or more, 3 lived twelve years or more and 1 lived more than fifteen years after operation.

INTESTINAL TRACT.

Incidence of Peptic Ulcer and Carcinoma in the Duodenum. Lichty⁹⁰ points out that although cancer of the duodenum was first described by Hamburger as early as 1746, since that time the lesion has been found only occasionally. Ulcer of the duodenum was first mentioned in medical literature in 1817. In 1830, it was possible to collect only 5 cases from the literature, and in 1894—only twenty-five years ago—a thesis by Collins (Paris) contained a summary of 257 cases recorded to that time, with notes of 5 additional cases observed by him. It is interesting to note, therefore, that while carcinoma of the duodenum has been known for almost two centuries it is now seen scarcely more frequently than when it was first described. Of 808 cases of cancer of the intestine collected by Nothnagel and others, only 42, or 4.5 per cent., were of the duodenum; and of cancers in general, statistics show that only about 0.34 per cent. occur in the duodenum.

It is possible to find but few satisfactory reports in the literature of cases of carcinoma of the duodenum located exactly in the most frequent ulcer-bearing area, *i. e.*, within the first one and a half inches of the gut. Most reports seem to be of growths which come directly from the pyloric ring or immediately from the papilla of Vater. Apparently, the cancer-bearing areas and the ulcer-bearing areas do not coincide in the duodenum as they do in the stomach.

Mechanism of Acute Duodenal Occlusion. Hóyer⁹¹ applies this term to what others call acute arteriomesenteric occlusion, duodenojejunal ileus or acute gastroduodenal atony. The acute dilatation of the stomach is usually the most striking feature of the clinical picture, and

⁸⁹ Surgery, Gynecology and Obstetrics, 1918, xxvi, 367.

⁹⁰ New York State Journal of Medicine, 1918, xviii, 433.

⁹¹ Norsk Magazin for Lægevidenskaben, August, 1918. (Abst., Journal of the American Medical Association).

lavage of the stomach, with change to the prone position, often bring relief and cure. The acute condition may occur from some mechanical hindrance or from paralysis of the stomach, or from both of these conditions. The mechanical hindrance may be a reflex spasm of the pylorus from an impacted fragment of food; or it may be a polyp, or a kinking of the pylorus or upper duodenum; or it may result from pressure from a tampon as after a gall-bladder operation. When the mechanical hindrance is lower down, in the lower duodenum or upper jejunum, the clinical course is less acute; the vomit contains bile, but no fecal matter; the peristalsis of the stomach is lively but the organ remains undilated; in these cases no benefit is derived from a change to the prone position. Gastropstosis seems to afford a predisposition.

Hóyer's experimental research on dogs has confirmed his clinical deductions. The explanation of the whole trouble, irrespective of whether or not there is dilatation of the stomach, is that the bowel becomes obstructed by paralysis and dilatation of the lower duodenum. The occlusion is induced by some kinking, or by some fold or valve formation at the duodenojejunal flexure. Possibly cases occur in which without any actual mechanical occlusion, the lower third of the duodenum becomes too weak to force its contents through the lumen of the flexure.

The medical measures useful for this emergency include lavage of the stomach, elevation of the pelvis and change from the dorsal to the prone or the knee-elbow position; merely lying on the right side may bring some relief. No food should be allowed by the mouth; fluids should be given by the rectum. If no immediate relief is obtained, operative measures are indispensable. Jejunostomy, with a drain introduced into the duodenum, seems rational to Hóyer, or, possibly better yet, the exposure of the duodenum after dividing the gastrocolic ligament between two ligatures, and the mobilization of the flexure, the making of a small opening into the duodenum and the insertion of a drain. The cases on record in which gastrostomy or gastrojejunostomy was done or in which the duodenum was merely evacuated have given bad results.

Chronic Arterioesenteric Occlusion of the Duodenum. Romme²² refers particularly to this variety of obstruction of the bowel in persons inclined to ptosis. The occlusion of the duodenum may not be complete, but it may be enough to induce digestive disturbances ascribed to various causes, but which in reality result merely from this partial arterioesenteric occlusion. Radioscopy shows vigorous peristalsis, but the duodenal contents do not seem to pass along. Unless this chronic partial obstruction of the duodenum in visceroptosis is thought of and sought, treatment is liable to be misdirected. If the individual can be made to put on flesh, the tendency to ptosis is reduced and the occlusion may subside in the milder cases. With the more pronounced form, the same mechanical measures as with the acute occlusion may be necessary, reclining prone, or taking the knee-chest position. If conditions

²² Presse Médicale, Paris, 1918, xxvi, 45. Harvey: Annals of Surgery, 1918, lxvii, 641.

are so grave that operative measures have to be considered, most surgeons prefer duodenojejunostomy or resection of the right half of the colon.

Jejunostomy. INDICATIONS AND METHODS. C. H. Mayo⁹³ summarizes his experience with the operation of jejunostomy. The latter has been done in the Mayo Clinic in 43 cases for nutritive purposes since 1910. In the larger number of cases the operation was necessitated by cancer, and was of a palliative nature. Because of the serious condition of the patients, the primary mortality was high and the palliation brief. The operation does not seem to be one of great utility, except in a few rare cases of non-malignant obstruction, or for the temporary relief of gastric fistula following perforation and operation. Twelve of the 43 patients died within a week, 4 died within a month, 4 within two months, 7 within a year and 3 within a year and a half. Thus in all of these cases the operation served its purpose, namely, that of affording temporary or permanent relief of the condition which necessitated the operation.

Intestinal Actinomycosis. Keefe⁹⁴ does not believe that actinomycosis of the digestive tract ever occurs in the stomach or small intestines. An acute or chronic inflammation of the appendix may open the door for the entrance of the actinomycosis organism. The infection is practically never carried by the lymphatics, and very rarely by the blood stream. The method of extension of the pathological process is by contiguity of tissue. Hence, general actinomycosis, unlike tuberculosis and blastomycosis, is extremely rare.

A firm swelling, painless on pressure, and occupying either the right or left inguinal regions, most often the right, is the usual result of intestinal actinomycosis. The diagnosis of the disease is, however, generally overlooked, and its presence only suspected when the resulting sinuses show a tendency to persist indefinitely.

The surgical measures employed to combat the disease consist of excision in some cases and incision and drainage in others, or a curetting of the diseased tissues together with the use of antiseptics and the maintenance of free drainage. Injections of a 4 per cent. aqueous solution of liquor formaldehydi have been employed with success. Vaccines and serums have been found of value only in a few reported cases. The Roentgen ray has not shown any marked beneficial results. In a few instances radium has shown marked benefit. Large doses of potassium iodide (90 grains, three times a day) have been given with success in many cases. The marked efficacy claimed for this drug is readily explained by the fact that it promotes the absorption of granulation tissue, acting in very much the same manner as in the cases of granuloma of tertiary syphilis.

Intussusception. Three hundred and seventy-four cases of intussusception which were treated by laparotomy at St. Thomas's Hospital from 1898 to 1917 are analyzed by Romanis.⁹⁵ The total mortality was 121, or 32.3 per cent.; this includes a decrease from 48.1 per cent. for

⁹³ Journal: Lancet, 1917, No. 23, xxxvii.

⁹⁴ Journal of the American Medical Association, 1918, lxxi, 1434.

⁹⁵ Romanis: Practitioner, 1918, ci, 152.

the four-year period, 1898 to 1902, to 19.2 per cent. for the period 1913 to 1917. The lowest annual mortality was (1905) 10 per cent. There has been a more or less continuous increase in the number of patients operated upon, and a progressive lowering of the death-rate, due to the fact that patients have come to operation earlier. Many minor alterations in the technic of treating the emergency have been, and are still being, introduced from time to time.

In intussusception operations in particular, the time-factor is of tremendous importance, and every minute saved during the operation on these infants and tiny children increases the chances of recovery. The harmful effects of general anesthesia in infants was recognized by Romanis, and every effort was made either to reduce the duration of the necrosis to the minimum in various ways, or, better, to substitute spinal anesthesia in its place. Early operation, a rapidly performed operation, and as little anesthesia as possible are the three factors, in Romanis's opinion, which offers the most probable explanation of the decided improvement in the results of the surgical treatment of these cases.

The different operations performed in this series were as follows: (1) Laparotomy, reduction and appendicectomy in 30 cases, with mortality 40 per cent.; (2) laparotomy and reduction in 301 cases, with mortality 26 per cent.; (3) laparotomy, resection and union in 30 cases, with mortality 63.3 per cent.; (4) laparotomy, resection and artificial anus in 10 cases, with a mortality of 100 per cent.; (5) laparotomy and lateral anastomosis above and below the tumor in 3 cases, with a mortality of 33.3 per cent. This bears out the well-known fact that if anything more than the simple procedure of opening the abdomen and reducing the invagination is required, the mortality rises by leaps and bounds.

The important question of the reducibility of an intussusception depends almost entirely on the interval that has elapsed between the onset of symptoms and the performance of the laparotomy. Of the above cases, in only one case in which operation was performed within twenty-four hours of the onset of symptoms was a resection necessary; of the cases dealt with, between twenty-four and thirty-six hours after onset, only 2 required resection; and of those in which the interval was between thirty-six and forty-eight hours, 4 were irreducible. All the other patients, in whom an enterectomy was found necessary, had been ill for over forty-eight hours before operation was performed. Fortunately, 89.2 per cent. of all intussusceptions can be reduced on opening the abdomen.

A New Operation for Visceroptosis. Goffe⁹⁶ considers that four forms of treatment are indicated for visceroptosis: (1) Internal medical therapy for eliminating intestinal toxins; (2) mechanical therapy, including gymnastic exercises, postural treatment, belts and corsets; (3) surgical treatment to restore normal position; to relieve obstructive angulation, or false adhesions, or irritative pressure on the sympathetic ganglia; and (4) neurological treatment to relieve depression. Goffe describes his method of operating for these conditions.

⁹⁶ Journal of the American Medical Association, 1918, lxxi, 1107.

Several incisions are necessary. A longitudinal or transverse incision is made below the umbilicus. Through this the lower half of the abdomen is thoroughly explored and any abnormalities which are found are dealt with in accordance with ordinary surgical principles. The incision is then closed. A longitudinal incision is then made above the umbilicus through which the upper abdominal cavity is thoroughly explored. Any pathological conditions discovered are dealt with according to indications; new incisions are made or the original one is enlarged if necessary.

"The stomach is then delivered through the wound. If dilated, the anterior wall is depressed with a sound along its middle line, and over this the stomach wall is plicated with a double row of linen sutures. In a line just above or below this, and midway between the extremities of the stomach, two or more linen sutures are threaded along in the stomach wall, including the peritoneal and muscular coats, each one being buried for from one-half to three-fourths of an inch. The stomach is returned to the abdominal cavity. The sutures still untied are left long and protruding from the wound, wrapped in sterile gauze. The transverse colon is now delivered through the wound, the omentum ligated along the border of the intestine and cut away. The hepatic flexure is picked up and two sustaining linen thread sutures are threaded along in its walls similar to those in the stomach, left long and protruding through the wound and protected by sterile gauze. Next the splenic flexure is exposed and treated similarly, and finally the transverse colon at its middle section. These sutures are all passed either just below the attachment of the mesocolon or in the broad band of the colon. The latter is firm and holds well, and is to be preferred when the colon wall is thin and distended. Three incisions two and a half inches long are now made through the skin down to the deep fascia, one parallel to the border of the ribs over the seat of the splenic flexure, another corresponding to this over the hepatic flexure at a slightly lower level, and a third, a transverse incision, at the midline over the stomach. The long sutures are threaded singly into a Peaslee needle, passed successively into the abdomen through the abdominal wound and brought out in the bottom of the skin incisions previously described. First, the stomach sutures are passed emerging in the midline incision, the stomach restored to normal position, and the sutures drawn taut, tied and cut short. The three pairs of sutures in the colon are successively passed in the same way, each pair in the three designated loci of the colon being directed to the incision in its corresponding location. All the sutures are drawn taut to straighten out the intestine and make intimate contact between the intestine and the parietal peritoneum, and then tied externally to the fascia in the bottom of the incision and cut short. The three incisions are then closed with a subcuticular catgut suture and sealed with sterile collodion."

Incompetence of the Ileocecal Valve. According to Case⁹⁷ it is possible to demonstrate an incompetent valve in about one-sixth of the patients

⁹⁷ Journal of the American Medical Association, 1918, lxxi, 1107, quoted by Kellog.

with gastro-intestinal symptoms who are studied roentgenographically. Kellog⁹⁸ believes that a deficient valve may cause a "stasis" in the intestinal canal. However, he believes that 19 out of 20 of these patients can be relieved by medical treatment. Other conditions are frequently present in addition which by themselves are sufficient indication for operation.

Cecal Stasis. Some experiments of Alvarez and Starkweather⁹⁹ seem to explain the mechanism of fecal stasis. Excised strips of muscle from the cecum of rabbits and guinea-pigs show little tendency to contract rhythmically in oxygenated Locke's solution. The records obtained are different from those traced by segments of the small or large intestine. The irritability of the strips is low and the latent periods are long. The low catalase content of the muscle suggests also that its metabolism is sluggish. These peculiarities probably account for the retention of food in this organ for long periods of time.

A preliminary report is made by Brewster¹⁰⁰ of the results in a series of 19 operations in which the right colon was excised for relief of symptoms attributed to blocking of feces in the cecum. In summing up the results of these operations, Brewster is convinced that cases of right-sided chronic obstruction with stasis in the cecum or ileocecal region, the result of mechanical or apparently mechanical causes, may be successfully cured by resection of the right colon, if previously unrelieved by any palliative method of treatment. Operation can be done without undue immediate risk; the 20 cases reported by Mayo, the 12 by Johnson and the 19 of Brewster were done without a subsequent death; but operation is too serious to be undertaken except for very definite conditions of incurable partial obstruction. The indications for excision are dilatation of the cecum, extreme mobility, presence of adhesions in patients unrelieved by any palliative treatment, especially when the symptoms lead to chronic invalidism.

Developmental Reconstruction of the Colon. From laboratory and clinical studies, Draper¹⁰¹ is convinced that his provisional hypothesis regarding the cecocolon and its relative unimportance and frequent danger to the human economy is correct. Bryant's studies, as well as the work upon right colonic resection and exclusion of Bloodgood, Mayo, Ochsner, Satterlee and others,¹⁰² compel general attention to the cecocolon. "The far-reaching variations in the syndrome of human symptoms, varying in all grades from the neuromental to the arthritic, and which in properly chosen cases are cured or improved by right-sided resection, show the problem to be one of the most fundamental in all medicine." On the basis of these studies, Draper proposes the removal of the last 10 cm. of the ileum and the entire cecum and ascending colon as far as the right margin of the great omentum—roughly this corresponds to the distribution of the colica dextra artery—for toxemic

⁹⁸ *Annals of Surgery*, 1918, lxxvii, 83.

⁹⁹ *American Journal of Physiology*, 1918, xxxii, 568.

¹⁰⁰ *Annals of Surgery*, 1918, lxxviii, 203. Reed: *Journal of the American Medical Association*, 1918, lxx, 1584.

¹⁰¹ *Annals of Surgery*, 1918, lxxvii, 567.

¹⁰² *Ibid.*, quoted by Draper.

conditions which find their source of origin in the cecocolon. The procedure is called the "developmental reconstruction of the colon."

The subjective symptoms of this condition, and for which operation is said to be indicated, are either neuromental or arthritic. The objective symptom is "cecocolonic degeneration," and is evidenced in a segmental infection of the cecocolon, in an elbow deformity (Lynch) of the mid-ascending colon or in an anomalous anatomical arrangement resulting from an exaggerated non-fusion of the mesentery.

Draper acknowledges that the procedure is fraught with great danger and should never be undertaken until exhaustive individual studies have been made, until modern and efficient medical therapeutics has been persistently tried, and after all other sources of trouble—tonsils, teeth, crevices, hernia, hemorrhoids, etc.—have been removed.

THE FUNCTIONAL RESULTS OF THE VARIOUS TYPES OF INTESTINAL ANASTOMOSES. Operators are usually in the habit of making side-to-side anastomoses in their intestinal work for the reason that the procedure is much safer than an end-to-end union. The empiric belief which has heretofore been held that the latter type of operation yields a superior functional result is supported by proof furnished by Draper. The following Table, which is taken from Draper's communication, is self explanatory.

DEVELOPMENTAL RECONSTRUCTION (DRAPER).

Before operation.			After operation.			
	E lapse of time between meal and x-ray.	Remarks—stomach emptying.	E lapse of time.	Remarks.		Number of days post-operative.
				Stomach emptying.	Anastomosis emptying.	
A						
End-to-end anastomosis, 3 cases:						
1. Dog 170 .	2 hrs. 50 min.	Slight residue	3 hrs. 30 min.	Normal	No delay	7
2. Dog 174 .	3 hrs. 40 min.	Slight residue	3 hrs. 25 min.	Delay	No delay	13
3. Dog 191 .	2 hrs. 50 min.	Slight residue	3 hrs. 20 min.	Delay	No delay	14
B						
Side-to-side anastomosis, 3 cases:						
1. Dog 175 .	3 hrs. 40 min.	Empty	3 hrs. 20 min.	Marked delay	Slight delay	10
2. Dog 192 .	2 hrs. 50 min.	Slight residue	3 hrs. 40 min.	Marked delay	No delay	12
3. Dog 203 .	3 hrs. 0 min.	Empty	3 hrs. 0 min.	Marked delay	No delay	12
C						
End-to-side anastomosis, 3 cases:						
1. Dog 186 .	3 hrs. 5 min.	Residue	3 hrs. 15 min.	Moderate delay	No delay	13
2. Dog 198 .	3 hrs. 10 min.	Residue	3 hrs. 10 min.	Slight delay	Delay	10
3. Dog 206 .	3 hrs. 5 min.	Residue	3 hrs. 5 min.	No delay	No delay	6

End-to-end Anastomosis between Small and Large Intestine. Balfour¹⁰³ emphasizes the utility of doing an end-to-end anastomosis between the small and large intestine because of the elimination of two steps in the next best operation, namely an end-to-side anastomosis. When the lumen of the small gut approximates that of the colon, conditions lend themselves readily to the union; when the lumen of the ileum is appre-

¹⁰³ Surgery, Gynecology and Obstetrics, 1918, xxvii, 248.

ciably smaller, the difference in caliber can be eliminated by increasing that of the small gut by an appropriate incision as indicated in Fig. 50.

The method of union by suture follows that described last year by Lockhardt and Mummery, and practically resembles a two-layer anas-

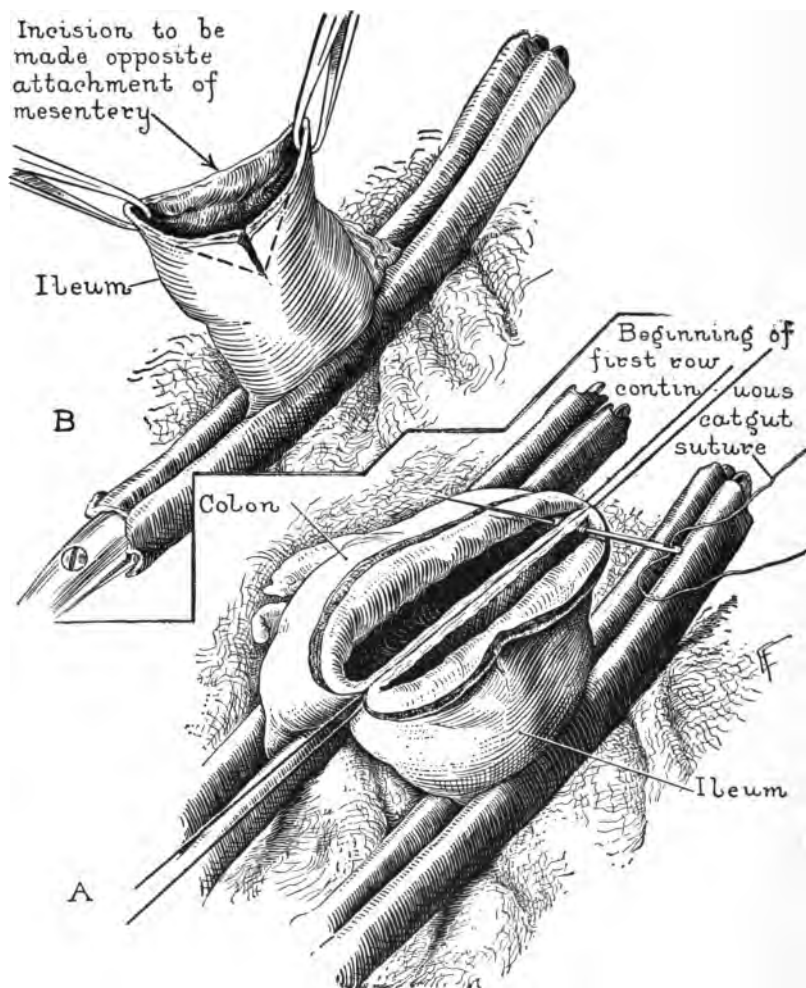


FIG. 43.—A, ileum and colon aligned and posterior row of sutures begun. B, method of increasing caliber of ileum when not of sufficient size for direct anastomosis. (Balfour.)

tomosis as in a gastrojejunostomy. The suture line is guarded by fat tabs or omentum. The steps are illustrated in Figs. 49 to 52.

ASEPTIC METHOD OF INTESTINAL ANASTOMOSIS. The method is described by Grey.¹⁰⁴ The peritoneal and muscle layers are divided and

¹⁰⁴ Bulletin of the Johns Hopkins Hospital, 1918, xxix, 267.

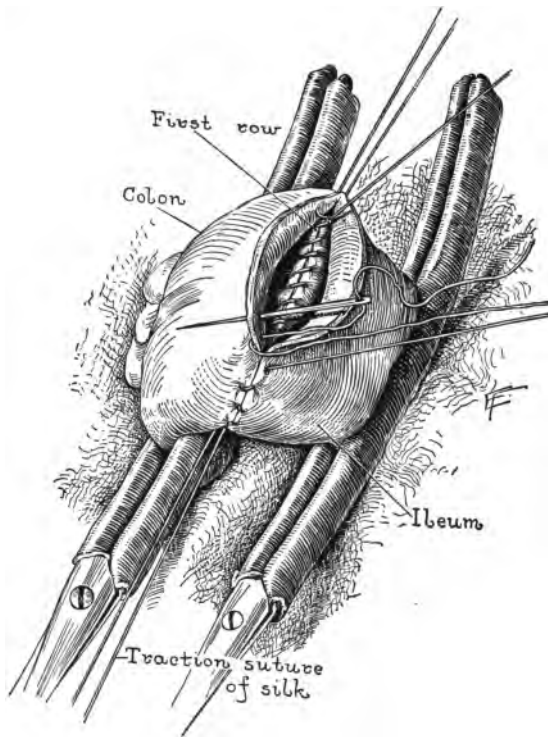


FIG. 44.—The posterior suture completed and the anterior suture begun. (Balfour.)

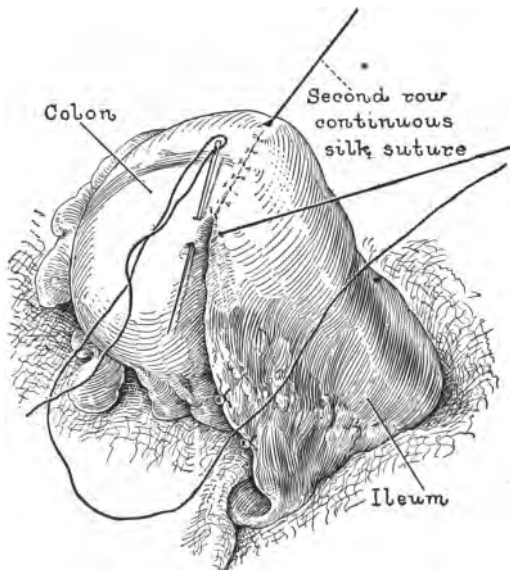


FIG. 45.—Second suture of silk completing anastomosis anteriorly. (Balfour.)

peeled back, after which the mucous tube is divided. A conical-shaped bolus of fibrin is pushed into either end and tied with a new wire-release ligature, after which the ends are sutured together. The ligatures are released and the bolus freed with restoration of the lumen. The method is still in a somewhat experimental stage.

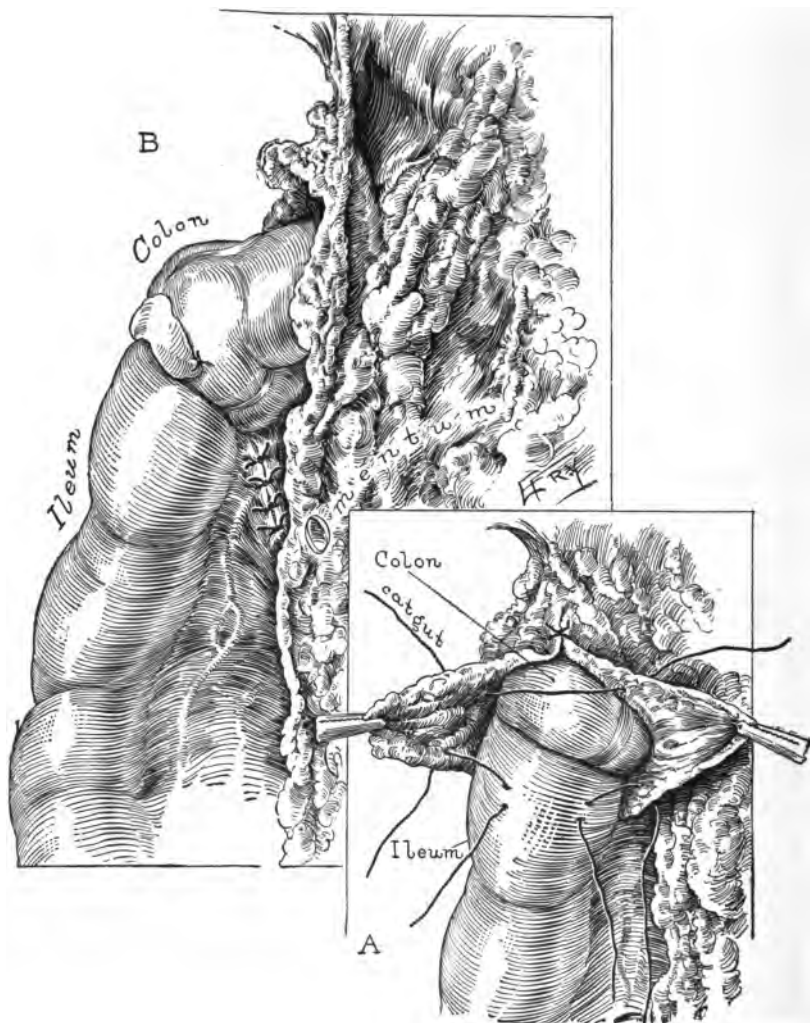


FIG. 46—A, anastomosis completed and omental cuff prepared for fixation over suture line; B, anastomosis completed and protected by fat tag when omentum is not available. (Balfour.)

Experimental Intestinal Obstruction. In the experiments of Smith and Hardt¹⁰⁶ a majority of the dogs with isolated intestinal loops succumbed to a perforative peritonitis. The development of toxic symptoms

¹⁰⁶ Archives of Internal Medicine, 1918, xxi, 307.

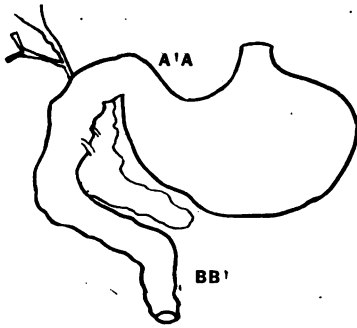


FIG. 47.—A'A-BB', duodenum with its outbuds, the pancreas and liver. (Elsberg and Draper.)

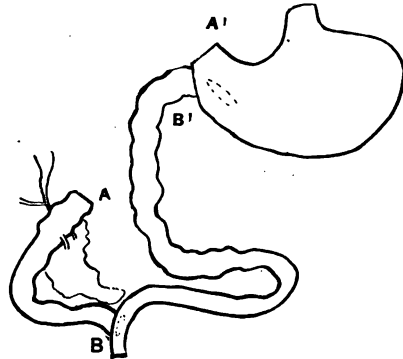


FIG. 48.—A', oral occluded pylorus; B', aboral jejunum anastomosed to stomach; A, aboral occluded pylorus; B, oral jejunum anastomosed to ileojejunum. (Elsberg and Draper.)

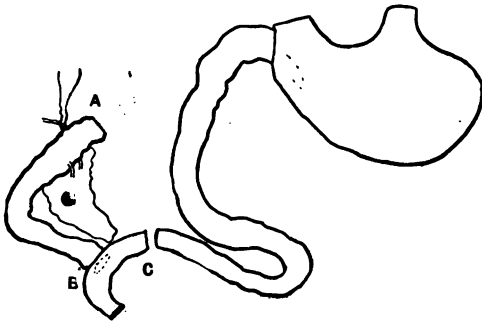


FIG. 49.—Same as Fig. 48 with an obstruction. (Elsberg and Draper.)

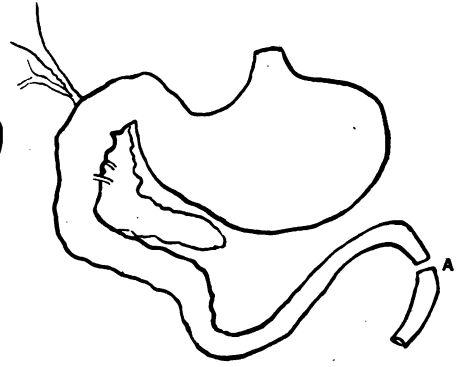


FIG. 50.—A, obstruction at ileojejunum corresponding to obstruction at C, Fig. 49. (Elsberg and Draper.)

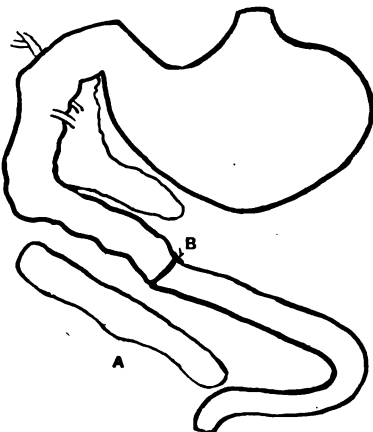


FIG. 51.—A, occluded loop; B, reconstructed alimentary canal. (Elsberg and Draper.)

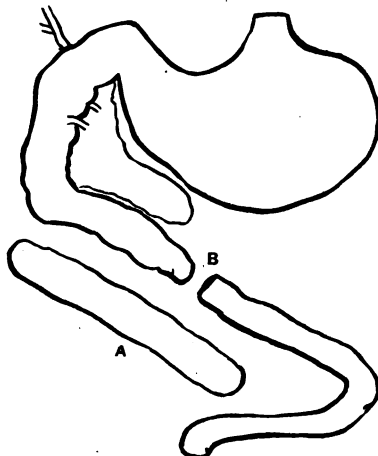


FIG. 52.—A, occluded loop; B, obstruction of alimentary canal. (Elsberg and Draper.)

and death could occur, however, independently of a peritonitis. The symptoms following the injection of the loop contents were different from those due to absorption in the body. Washing of the loop delayed the development of symptoms and the onset of death. The loss of body weight was not great enough to seem an important factor in the process. Overdistention and strangulation of the loop of intestine did not appear to be necessary factors in the development of symptoms. The animals lived indefinitely with loops draining externally, or with loops draining directly into the peritoneal cavity.

Elseberg and Draper¹⁰⁶ have been working on the problem of intestinal obstruction by means of duodenal transplantation experiments. Their methods of experimental operative procedure are well illustrated in the figures reproduced herewith (Figs. 47 to 52).

Duodenal transplantation definitely shows that the duodenum and its appendages, singly or collectively, produce the lethal agent which causes death in intestinal obstruction. Under certain conditions, a proteose may be isolated which causes death when injected. Further definite corroboration, however, is necessary to prove that this test-tube product is identical with the vital lethal product of acute obstruction. The lethal agent is probably similar to parathyroid or other endocrine secretions and acts in a similar manner.

Additional evidence is accumulating that death caused by intestinal obstruction is due to toxins originating in the epithelium of the duodenum and its appendages. Rogeré, and more recently Whipple and his associates,¹⁰⁷ have laid special emphasis on a proteose isolated from the duodenal region. Sweet¹⁰⁷ and his associates have laid special stress on the pancreas. Dragstedt, Moorhead and Burcky,¹⁰⁷ on the other hand, again take up the bacterial origin of the toxemia.

Davis and Stone¹⁰⁸ have recently shown that normal intestinal secretion is non-toxic upon intravenous injection. This was to be expected, inasmuch as dogs show no intoxication after the production of open intestinal loops that are permitted to drain into the abdominal cavity. Such secretion, however, when kept free from preservatives and unheated, rapidly becomes toxic, producing the same effects upon intravenous injections as closed loop fluid. A rapid and profuse growth of bacteria in the secretion is noted, and while Davis and Stone do not consider it conclusively demonstrated that bacteria are responsible for the development of the toxicity, it is certain that the end-products of bacterial activity are concerned.

Brooks, Schumacher and Wattenberg¹⁰⁹ emphasize the importance of distinguishing clearly between two factors—the production of toxin and the absorption of toxin. In one of their experiments in which the maximum opportunity was afforded for the absorption of the toxic loop content, death resulted before the loop content had attained a high

¹⁰⁶ Journal of the American Medical Association, 1918, lxxi, 1634.

¹⁰⁷ Ibid., quoted by Elseberg and Draper.

¹⁰⁸ Quoted by Dragstedt, Dragstedt and Chase, American Journal of Physiology, 1918, xlii, 368.

¹⁰⁹ Annals of Surgery, 1918, lxxvii, 210.

degree of toxicity. In another experiment in which there was little damage to the mucosa from the operative procedure, and in which the occluded loop distended slowly and there was little nutritional change in the mucosa, the animal showed relatively little evidence of intoxication at the end of twenty-one days, although there was produced in the occluded loop 200 lethal doses of the toxic substance. In a third experiment, in which the loop was relatively shorter and higher up, and in which distention of the bowel and absorption of toxic substances developed more rapidly, there was an earlier appearance of symptoms.

The failure to develop symptoms in the instances of simple obstruction of loops for long periods, is not a result of the animals developing immunity. In a series of animal experiments, Dragstedt and Moorehead¹¹⁰ were able to demonstrate that there is no increased immunity or tolerance to intestinal obstruction after recovery from a previous obstruction. Dogs which had recovered from intestinal obstruction are more resistant to injections of closed loop fluid than normal animals. In dogs the normal variation in resistance, both to intestinal obstruction and to the injection of closed loop fluid, is large.

Dragstedt, Moorehead and Burcky¹¹¹ showed that symptoms appeared sooner and were more pronounced following interference with the circulation of the occluded loop.

Brooks, Schumacher and Wattenberg¹⁰⁹ do not deny that necrosis increases the rapidity of formation of the toxin, but they believe that actual visible tissue necrosis is not necessary for the production of a very toxic loop content. The toxic substance produced is, however, not absorbed through a normal intact mucous membrane.

The belief that the acute symptoms of intoxication which may follow the relief of an intestinal obstruction, are due to the absorption of the toxins of the obstructed bowel after the toxic fluid has passed into the normal bowel distal to the obstruction, is disproved by many experiments. That a patient may grow rapidly worse immediately after the release of an intestinal obstruction cannot be denied, but the reason for this is not that the normal bowel distal to the obstruction absorbs the toxic substance after it has passed through the point of previous obstruction. There are other explanations which are not contradictory to experimental work. It may be in such instances that the operative measures damage the mucosa at some point, *e. g.*, an intestinal anastomosis, and thus permit a more rapid absorption of the toxins already formed. In case of strangulation or volvulus, it may be that the operative relief of the obstruction to the blood- or lymph-vessels permits a more rapid absorption of the toxic loop content from the already damaged mucosa. Or it may be—and this seems to be the best explanation—that the patient had already absorbed a lethal or near lethal dose of the toxic substance before the operative procedure is undertaken; the operation becomes then merely an incident in hastening the onset of the fatality, rather from its general effects than from any effect on the subsequent absorption of the toxins.

¹¹⁰ Journal of Experimental Medicine, 1918, xxvii, 374.

¹¹¹ Quoted by Brooks, Schumacher and Wattenberg, *ibid.*

Spastic Ileus. Leonard Freeman¹¹² points out that the causes of spastic ileus are not clearly understood; probably there is a reflex neurogenous mechanism. In this form of obstruction, a section of the bowel, often only a few inches in length, becomes so firmly contracted that it is hard, white and bloodless, and remains rigid when picked up by one end. The symptoms are intermittent; they may be acute, dangerous and severe as in a mechanical obstruction; they may be mild and chronic, merely causing occasional pains and constipation. Frequently the diagnosis is in doubt; the opinion should then incline toward the existence of a mechanical condition in order to obviate any unnecessary fatality. Merely opening the abdomen generally relieves the spasmodic contraction, but later the contraction may return with possibly fatal effect. For this reason, Freeman advises short-circuiting the offending loop.

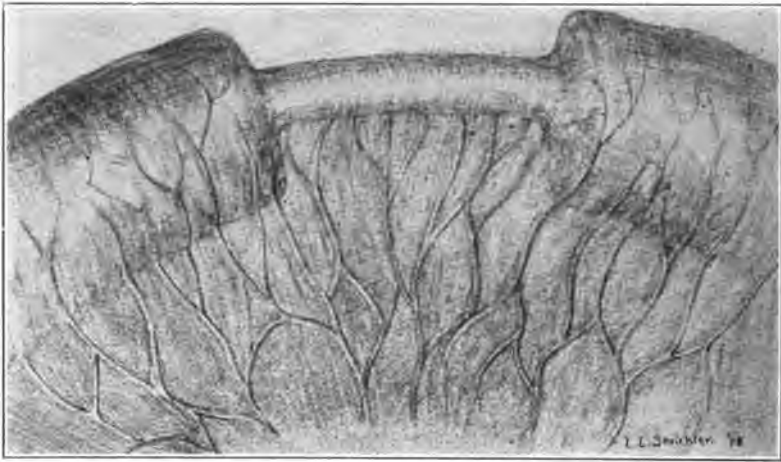


FIG. 53.—Illustrating spasm of small intestine in spastic ileus (diagrammatic). (Freeman, *Annals of Surgery*.)

Enterocolostomy for Intestinal Obstruction. Frequently the relief of an obstruction is only temporary, in that the impairment of peristalsis existing before operation continues unabated, or is recovered from so slowly as to permit a reaccumulation of toxic intestinal contents and a subsequent fatal issue. The enterostomy, which it becomes necessary to do, is encumbered with the disadvantages of a fecal fistula, and in order to obviate the latter, Anspach¹¹³ proposes an enterocolostomy above the point of obstruction. He believes the latter operation especially valuable for the relief of obstruction following pelvic operations, especially when there is a pelvic peritonitis and much toxemia.

Colonic Fistula. C. H. Mayo¹¹⁴ indicates several methods for securing closure of a colonic fistula. These are practically always the result of some infectious process, and while it is uncommon for the fistula to open on the unbroken abdominal skin, communications are common after

¹¹² *Annals of Surgery*, 1918, lxviii, 196.

¹¹³ *Journal of the American Medical Association*, 1918, lxxi, 785.

¹¹⁴ *Annals of Surgery*, 1918, lxviii, 211.

operation; frequently the communication occurs with the bladder, or vagina; rarely in the ischiorectal fossa.

In large intestinal fistulæ, the repetition of closure operations forces a choice of a more radical procedure including therein a resection of the involved area and the employment of various side-tracking and anastomosing operations, such as an ileo-transverse-colostomy or ileosigmoidostomy, usually without and occasionally with, the addition of drainage of any pouch or excluded loop of intestine by a mucous fistula. In the small intestine, closure operations are much more successful.

Mucosa of Rectum and Sigmoid Colon as a Focus of Infection. Soper¹¹⁵ speaks of the lower colon being frequently invaded by pus-forming organisms. The infection is mixed in character and exhibits an extreme degree of chronicity. The resulting systemic disease varies from merely nervous disturbances, headaches, and constipation, to pus infection of the appendix and gall-bladder, to gastric ulcer, arthritis deformans, and chronic kidney diseases. Soper says that treatment by the dry powder insufflation method of Rosenberg is extremely efficacious. Calomel is the powder of choice for local use, as it adheres well to the mucosa, and cannot be easily dislodged. It is non-irritant and may be applied to the sensitive mucosa of the anal canal without producing pain. There is no danger from absorption. Not a single case of systemic disturbance followed the daily use of large quantities. Calomel is best because it probably has more antiseptic power than any other available powder. Soper emphasizes that in the search for foci of infection, the lower bowel must not be neglected.

Cancer of the Rectum. Desmarest¹¹⁶ describes his method of removing the lower rectum for carcinoma without sacrificing the anal sphincter. The operation is indicated in relatively high tumors, and is especially suitable for the female subject. The operation is done through two incisions (Fig. 54), a transverse perineal and a longitudinal coccygeal incision. The rectum is completely isolated from the surrounding structures down to the sphincter. Here the rectal tube is dissected from its muscular coats, the tumor-bearing portion is cut away, and the proximal end of the bowel is pulled through the anal tube, which is left, and is sutured in place to the skin margin. The essential steps of the operation are illustrated in the figures reproduced herewith.

Desmarest has applied this method in 21 cases, and the elapsed interval of three years since his first case enables him to speak confidently of the superior advantages of this technic. Thus far, recurrence of the growth has occurred in only 2 cases.

To say the least, an artificial anus, wherever it may be placed, is for most people an intolerable nuisance, and whenever conditions lend themselves readily and safely toward conserving the natural sphincter, it would be an act of cruelty to neglect making use of the advantage. The very nature of the illness, however, precludes the possibility of availing ourselves of this immeasurable advantage in any but a small minority of the cases.

¹¹⁵ Journal of the Missouri Medical Association, 1918, xv, 200.

¹¹⁶ Presse Médicale, Paris, 1918, xxvi, 180.

This method of operating is a modification of an old type of operation, which, at least in America, has been discarded. It was found that there is great likelihood of abscess formation in the immediate neighborhood of the site of operation in the pelvis, which serves to make diffi-

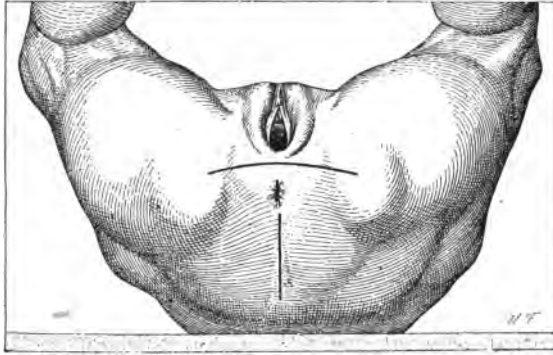


FIG. 54.—(Desmarest.)

cult and obnoxious the postoperative period, and to retard the complete convalescence for an extraordinary length of time. Abscesses have occurred, too, at long intervals of time after the apparent healing of the wound.

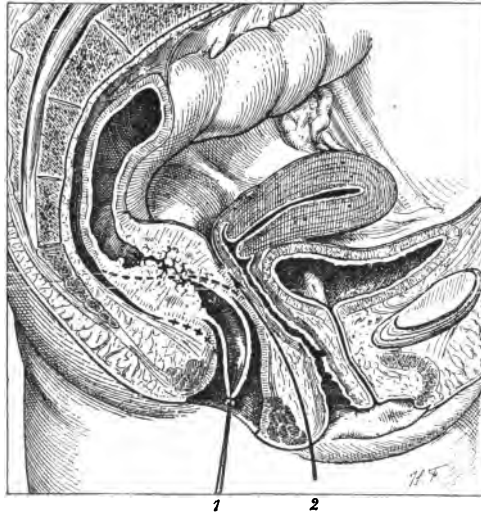


FIG. 55.—(Desmarest.)

The operation suffers also from the same general fault which distinguishes all of the perineal or sacral types of operation. A complete exploration of the abdominal organs and of the lymphatics in intimate association with the diseased area is not possible. In high tumors a complete operation is not feasible. These considerations have been most potent in creating the prevailing preference for the combined

abdominal and perineal operation for carcinoma of the rectum. The higher mortality of the latter type of operation is more than compensated for by the larger number of subsequent permanent cures. It is

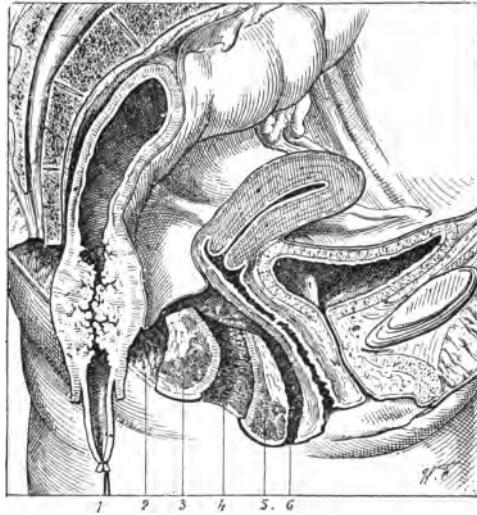


FIG. 56.—(Desmarest.)

worth while pointing out that with these severe operations, the immediate operative mortality is directly proportionate to the skill of the postoperative care, and especially of the postoperative nursing.

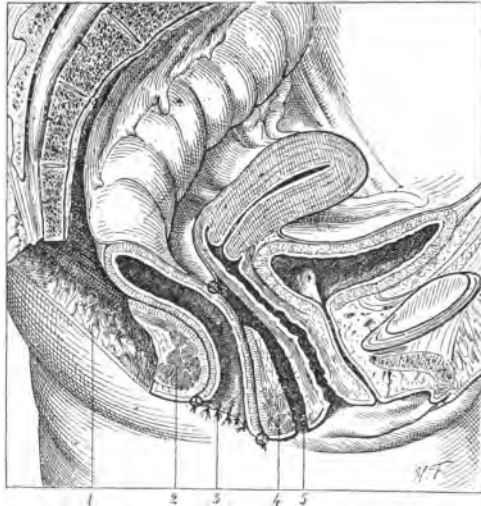


FIG. 57.—(Desmarest.)

Fistula in Ano. Edwards¹¹⁷ ascribes the failures following operation for fistula ani to one of three causes: (a) The typography of the fistula

¹¹⁷ Lancet, London, 1918, i, 673.

is not accurately established and hence part of the fistula remains; (b) caries of the coccyx or even of the sacrum; (c) tuberculosis. Another cause may be added, due to an erroneous diagnosis, and resulting from a dermoid cyst of the sacrum, suppurating and rupturing rather low down in the anal region.

The most important cause for the frequent bad results is found in the structure of the fistula. It is never easy to map out the track before operation, and during the operation a fine ramification is very easily lost in the manipulations. The use of wax or colored fluids, employed for facilitating the exposure of the entire track and its branches, does not always render the desired aid.

If it be possible to dissect out the entire track, a desideratum which is never obtainable in any but the simplest of fistulae, an attempt is justifiable to close the entire wound, and primary union can be obtained. It is usually, however, much more expedient to allow the wound, however small or large it may be, to heal from the bottom by granulation; and it cannot be overemphasized how important it is to have the postoperative dressings done correctly and assiduously, in order to secure a satisfactory result. Very often the failure to carry out the after-treatment properly becomes the immediate cause of the failure to cure the fistula.

The etiological factor of a tuberculous infection is not as frequent as it is generally supposed to be. In the rather extensive experience of a large laboratory, it is found that a tuberculous fistula is rather a rare occurrence.—(Reviewer.)

THE LIVER.

Tests of Liver Functioning. Gautier¹¹⁸ reviews the various tests employed for determining the functional capacity of the liver, and comments that all have the great drawback, that the reactions are not due to the liver alone. The effects of the metabolism of other organs obscure the interpretation of the facts observed. This is particularly noticeable with the urine tests. Most instructive is the study of the dissociated retention of the bile elements, especially the retention of salts which come only from the liver, and the study of glycuronic acid. These tests throw most light on the functional capacity of the liver. Glycuronuria and Rogers's reaction seem to be the only signs of importance for prognosis.

According to Dedichen¹¹⁹ urobilinuria is a constant finding with liver disease when the bile is not shut off from the bowel; with rare exceptions, a pronounced urobilinuria is regarded as a sign of absolute insufficiency of the liver.

The Cirrheses of the Liver. Some anatomical and physiological facts relating to the functions of the liver are reviewed by William J. Mayo¹²⁰ as pertinent to the pathology of the cirrheses. The hepatic artery is, relatively, a small vessel, and nourishes the liver itself, its framework, the biliary channels and the gall-bladder. The liver cells, in the process

¹¹⁸ *Revue Médicale de la Suisse Romande*, Geneva, 1917, xxxvii, 597 (Abst., *Journal of the American Medical Association*).

¹¹⁹ *Norsk Magazin for Laegevidenskaben*, Christiania, Abst., *Journal of the American Medical Association*, 1918, lxx, 278.

of acting on the portal blood are nourished thereby, and, in this respect, there is no distinction between the blood of the hepatic artery and that of the portal vein. Of the two large trunks which make up the portal vein, the splenic branch carries to the liver from one-eighth to one-sixth of the total quantity of portal blood. This is most important as it indicates that the removal of the spleen relieves the liver of a large load of blood; and, as shown by the results of splenectomies, this diversion to the general circulation may be sufficient to relieve the subnormal liver of its overload and enable the patients to return to a fair degree of health in otherwise fatal cases. Double ligation and division of the inferior mesenteric artery and vein where they cross the left common iliac vein, or just beyond at the promontory of the sacrum (superior rectal vessel) would also greatly reduce the portal circulation. An enormous compensatory circulation is caused to be established by the latter operation through the middle and external hemorrhoidal vessels.

Mayo speaks of the remarkable capabilities for regeneration which the liver possesses; of its metabolic activities in relation to the proteins, carbohydrates and fats; of its defense function against the invasion of the organism by bacteria. The fat function of the liver is not well understood. It is probable that under certain circumstances carbohydrates are converted into fat in the liver. In acute stress, such as occur in phosphorus and chloroform poisoning, and in massive infections, the liver undergoes a most rapidly fatal fatty degeneration. This seems to be the usual response of the liver to any destructive agency. In the metabolism of carbohydrates, proteins and fat, the liver completes a process begun in the gastro-intestinal tract; in the next two—the secretion and excretion of bile and the defense function—the spleen becomes associated with the liver and the gastro-intestinal tract.

It is difficult to state whether the production of bile is purposeful or whether the bile is a waste material which assumes a useful role in intestinal digestion. The bile pigments are derived from destroyed red corpuscles carried to the liver, partly from the spleen. When enormous quantities of blood are destroyed, as in hemolytic icterus, the liver, as well as the spleen, becomes greatly enlarged; and accumulating evidence proves that while such a liver may contain an increased amount of connective tissue, the latter is not necessarily related to the biliary channels. To a very large extent, the enlargement may be looked upon as a work hypertrophy with hyperplasia of the liver cells.

The defense function of the liver is most important. Bacteria are constantly being carried to the liver from the area drained by the portal circulation. The spleen strains out many organisms—typhoid bacilli, protozoa, and, especially, the plasmodium of malaria and the spirochete of syphilis; but it may be unable to destroy these organisms, and they are sent to the liver for destruction. It seems fairly clear that portal cirrhosis is related to the defence function; the liver, losing power to absorb and eliminate diffuse poisons, attempts to encapsulate them. "The spleen has been compared by Rowntree to the glomeruli of the kidney, and the liver to the tubules, the one straining out the degenerated cells, microorganisms and poisons, and the other acting on the material

brought to it. The interrelated pathological condition of the spleen and liver follows closely this interrelation of function."

CLASSIFICATION OF THE CIRRHOSSES. Cirrhosis is a term applied indefinitely and indiscriminately to almost any condition of the liver which is not understood, but with which there is associated an excess of connective tissue. Such deposit is, however, the outstanding feature of all liver disease, the result of chronic irritation and without regard to cause. It is well shown in the local cirrhotic processes which may accompany cancer, syphilis and tuberculosis of the liver. The pathological classifications are based on morphology and the morphological pictures are sometimes differently interpreted by the various authorities. Generally speaking, fundamental types of cirrhosis are distinguished by Mayo,¹²⁰ the others representing combinations or variations, rather than entities.

The two types are : (1) Portal cirrhosis in which the chronic irritants, probably biochemical substances, are introduced through the portal vein, and in which circulatory disturbances are the most prominent clinical features, causing gastric hemorrhages, and especially ascites. Jaundice is seldom present and only as a terminal symptom. (2) Biliary cirrhosis, in which jaundice is clinically the chief symptoms, ascites being absent or, if present, being a terminal condition, with the evidence pointing to an infectious cause.

In portal cirrhosis the connective tissue is introduced about the portal vein radicals, and in biliary cirrhosis about the bile ducts. In both portal and biliary cirrhosis the spleen is often enlarged; in many cases it has a causative relation, such as in the terminal portal cirrhosis of the splenic anemias the so-called Banti's disease. While typical portal cirrhosis, on the one hand, and typical biliary cirrhosis, on the other are well defined, atypical forms exist from mixed causes, as a portal cirrhosis with secondary biliary cirrhosis from gall-stone infections.

Mayo expresses the opinion that in the large majority of the cases, Hanot's cirrhosis is either a hemolytic icterus, or the ordinary type of biliary cirrhosis. Hemolytic icterus is primarily a splenic disease with a work hypertrophy of the liver. If one bear in mind that, without regard to the nature of the irritant, the response in the liver is connective-tissue formation, and that this may involve the whole liver, or occur locally, some of the confusion is readily explainable.

COMPARISON OF PORTAL AND BILIARY CIRRHOSIS. Mayo¹²⁰ believes that the relation of alcoholic stimulants to cirrhosis of the liver, at least in this country, has been exaggerated. A considerable number of cases of portal cirrhosis in non-alcoholic young persons have been described. Fagge⁸³ shows that in Guy's Hospital for twenty-five years 14 per cent. of those dying from portal cirrhosis with ascites had complicating tuberculous peritonitis. Cheadle, and others, have shown that, while the Laennec type of atrophic cirrhosis stands at one end of the group, representing the typical gin or hobnail cirrhosis of the liver, as many cases are to be found in which the weight of the liver is increased as there are

¹²⁰ Journal of the American Medical Association, 1918, lxx, 1361.

those in which it is diminished; and the belief that such huge livers finally contract down to the Laennec type is unfounded. In biliary cirrhosis, the liver is always enlarged.

The margin of safety in the liver is very great. The patient with portal cirrhosis rarely dies from insufficiency of hepatic tissue, but death is usually brought about through changes in the circulation and because of secondary complications, while in biliary cirrhosis death results from chronic jaundice and cachexia. The establishment of a compensatory circulation by which blood would be passed from the portal vein around the liver into the general circulation, as advanced and pictured by Talma, Drummond and Morison, has given marked palliation in suitable cases. Sappey⁸³ has accurately described the venous avenues by which such compensatory circulation is brought about through nature's unaided efforts.

It is of interest that in all the cases of Mayo, in which portal cirrhosis accompanied splenic anemia, the cirrhosis was of the atrophic type of Laennec. In these cases the removal of the greatly enlarged spleen has been followed by immediate relief to the portal circulation. In those cases in which cirrhosis was present, the ascites disappeared and several patients have lived for years—one for more than seven years—in excellent health. The evidence here points to the fact that the original poison was carried to the liver from the spleen. In the cases of portal cirrhosis with ascites, in which Mayo successfully removed the enlarged spleen, the patients who recovered were greatly improved both as to their general condition and as to the relief of the ascites. The success of the latter operations probably depends on a combination of circumstances which includes the removal of the source of the chronic poisoning and the diversion of a sufficient quantity of blood to relieve the portal circulation. The results in these cases should encourage one to splenectomize suitable cases of portal cirrhosis, especially when the spleen is enlarged.

Biliary cirrhosis, of the obstructed or acutely infected type exists in connection with gall-stones, particularly with stones in the common duct and jaundice is an early and continuous feature. In many of these cases, however, the patients are not cured by the removal of gall-stones and biliary drainage. More or less permanent damage has been done to the ducts, resulting in chronic areas of infection and often in deposits of stone in the bile ducts, until thousands of such stones may be found in the liver. A second type, which is not so well understood, accompanies certain chronic biliary infections. In these it would appear that either primary hematogenous infection of the bile ducts took place or that there was an extension from a chronically infected gall-bladder to the ducts.

In chronic biliary cirrhosis, the liver is large and the walls of all the biliary ducts are extremely thick. Every grade of biliary cirrhosis may be found in this chronic type, which is much more liable to be accompanied by an enlarged spleen than those dependent on the more acute infections of the common duct. Not infrequently, chronic pancreatitis is present from coincident infection. Mayo has seen cases of this description in which there was apparently much improvement after prolonged biliary drainage to the surface, or after a cholecystogastros-

tomy or cholecystoduodenostomy; but as the clinical course of these patients is very chronic, he is not at all sure that cause and effect are properly related. In 5 cases of this type, in all of which the spleens were enlarged and the patients were more than thirty-five years of age, Mayo performed splenectomy. All were improved, the jaundice was greatly reduced, though it had not entirely disappeared in any case, and the liver remained more or less enlarged. The same explanation is vouchsafed for the good results as was given previously.

There is a frequent failure to differentiate the ascites due to polyserositis (Concato's disease) and that due to portal cirrhosis. Fagge⁸³ states that for every 3 cases of portal cirrhosis with ascites, he saw 1 of ascites from polyserositis. Concato's disease may be recognized by the thick white peritoneum, by the intestines with greatly shortened mesentery clustered about the spine, and by the encasement of the liver and spleen in a thick white fibrous membrane. Free fluid is usually to be found in both pleural cavities. Pick's syndrome often exists, in which pericardial adhesions hamper the heart's action. The fact that, in some of these cases, the liver is completely encapsulated leads the uninitiated to believe that some form of cirrhosis is present; but, on excision of the strangling membrane, the liver will be found normal.

Warthin¹²¹ has pointed out that thrombosis of the portal vein or some of its branches occasionally occurs with ascites. This is a chronic malady accompanied with liver changes and splenomegalia, and the condition is usually confused with the portal cirrhosis of splenic anemia.

ASCITES WITH CIRRHOSIS OF THE LIVER. Simon's¹²² study of 212 cases of hepatic cirrhosis with ascites compares the outcome of the cases with and without omentopexy (Talma-Morison operation), and aims to create a true conception of the value of operative treatment for this condition. One point brought out by the compilation is the better prospect for success of the operation for Laennec's cirrhosis when the patients are in the thirties, instead of in the fifties, although successful cases are known in patients of sixty years or more. Compared with these 212 cases, are 142 cases at the Stockholm hospitals in which there was no surgical intervention. The cases in which syphilis is responsible for the cirrhosis give by far the best prognosis, provided the syphilis is well treated.

Study of all this material shows that the cases of cirrhosis of the liver with ascites fall into two great classes; those in which the ascites is the result of a progressive obstruction of the portal system by the encroaching cirrhosis—a purely local trouble; and those cases in which the portal system is not much obstructed but in which the weakness of the heart action entails the ascites. In the first group, omentopexy aids in the development of a collateral circulation and offers opportunity for relief and for an approximate clinical cure. Without some such intervention the patient is doomed. In the other group, the immediate prognosis is less grave, and omentopexy will have little influence on the course of events, and should be considered only as a means of last resort. Elements

¹²¹ Quoted by Mayo, *ibid*.

¹²² Norsk Mediciniskt Arkiv, Stockholm (Abst., Journal of the American Medical Association, 1918, lxx, 662).

which might turn the scale in favor of the operation are a good general condition, integrity of the omentum, age under or near forty, absence of jaundice, and the presence of very little extreme atrophy. Unfavorable findings with functional tests, etc., are not an absolute contra-indication. Simon adds that an exploratory laparotomy is the only sure means of determining the condition of the omentum and of differentiating the true nature of the liver disease. He advises operation as a routine measure when the abdomen must be repeatedly tapped. The omento-fixation can be extraperitoneal or by Morison's intraperitoneal technic. Simon suggests that it might be worth a trial to supplement the omentopexy with the introduction of a hollow silver button leading from the peritoneal cavity into the subcutaneous tissue.

The Mechanism of Bile Resorption in Jaundice. The mechanism by which the body becomes jaundiced is not yet completely understood. A summary of the available knowledge is given by Horst Oertel¹²³ together with the results of some of his own anatomical and microscopic observations. The conditions following a mechanical occlusion of the larger bile ducts are perhaps best understood and commonly summarized under the term obstructive jaundice. The classic example of obstructive jaundice is stone in the common or hepatic bile duct. This common picture may be variously modified and complicated by accompanying infections and inflammatory changes.

An exception which has experimental value is reported by Horst Oertel. It illustrates that a considerable, if not a complete, obstruction of the larger ducts may occur, sufficient to produce ectasia even in the smaller branches in the liver, without any general or even local hepatic jaundice and, apparently, even without subjective symptoms. This case belongs probably to the rare category, described by Rolleston, in which fading of pigmentation, almost to its disappearance, occurs.

Horst Oertel considers that the rapidity and manner of obstruction, together with the character of the bile, are of fundamental importance as regards the results of interference with the bile flow through the large extrahepatic ducts, so that even a complete obstruction may be regulated by a gradual adaptation to the new conditions. It is known that a resorption of bile in the liver occurs only with the existence of considerable over-pressure, which, according to Bürker¹²⁴ corresponds to 20 mm. Hg. The resorption takes place in the portal zone of the liver parenchyma, and not from the interlobular ducts. Much depends on the manner and rapidity with which the obstruction occurs. A thin, watery bile would be less apt to exert over-pressure, because it would be more apt to pass by the obstruction into the duodenum. A thick, slowly flowing, viscid bile would naturally have opposite effects.

The conditions leading to jaundice become much more complicated in those cases in which no gross obstruction is demonstrable—that is, in the various hematogenous or toxemic forms of icterus. It is now generally conceded that the liver is essential for the production of jaundice, although the observations of Whipple and Hooper seem to

¹²³ Archives of Internal Medicine, 1918, xxi, 21.

¹²⁴ Quoted by Oertel, *ibid.*

indicate that bile may be also formed on intravenous injections of hemoglobin into dogs, after exclusion of the liver from the circulation. The investigations of Jaonnavics point to the necessity of the spleen as a preparator of blood corpuscles for the production of bile by the liver. The exact mechanism is, however, not definitely known. Most generally accepted are the ideas of Stadelmann, Minkowski and the more definite views of Eppinger, Jr., according to which it is supposed that an excessive production of a pleiochromous, thick bile occurs (hypercholoia) which cannot be normally discharged, and therefore enters the blood (parapedesis). Eppinger, Jr., has furnished a more definite anatomic conception by demonstrating bile thrombi (intracapillary bile thrombosis) in the livers of these cases. According to these views, the hematogenous jaundice is, in the last instance, an intra-acinar obstructive jaundice.

There are other cases in which neither a thick, pleomorphic bile, nor bile thrombi, can be demonstrated. It has been suggested that the original bile thrombi have disappeared. This view is not accepted by Oertel, because the histologic picture in many of these cases is quite different from those in which the bile thrombi are found. Sterling has advanced the theory that jaundice may result from injury to liver cells, leading to disorganization or to occlusion of the smallest intracellular bile canals by swelling or fibrin plugs. But the great objection to this explanation is the fact that relatively few cases of parenchymatous degeneration or of edema of the liver are associated with bile retention and absorption, and that even quite general and extensive necrosis may occur without the slightest evidence of jaundice or even local bile precipitation. Jaundice may be either absent in the quite extensive necrosis accompanying venous engorgement, or merely a slight icteric tinge of the conjunctivæ is present, with very little evidence of bile precipitation and resorption in the liver itself. It is assumed, therefore, that parenchymatous swelling, cell loss and even extensive necrosis are in themselves not sufficient to account for jaundice.

From observations made in a number of cases of hematogenous jaundice (to which the views of Stadelmann and Eppinger, Jr., seemed not applicable), evidence was obtained by Oertel, which would make it appear that the icterus depends primarily not on the blocking of the finer ducts but on the lack of proper discharge of bile into the bile canaliculi; and that the latter is due to some alteration of the cell protoplasm. The actual cellular mechanism may be induced by ferment action, as Gideon Wells supposes. However, Oertel thinks it better to assume from present knowledge of the internal structure of protoplasm and from the morphological findings which he has described, that this fine diffuse bile precipitation depends on specific changes in the colloidal state of the cells induced by certain toxic substances. This would explain why some infections and intoxications are more apt to lead to icterus than others.

Oertel comes to the final conclusion that bile resorption in hematogenous icterus may occur by intra-acinar lymph and blood resorption almost simultaneously.

Jaundice as a Cause of Bleeding.¹²⁵ It has long been an established fact that in certain types of jaundice there is a definite delay in coagulation time. Morawitz and Bierich believed that the altered coagulation time was independent of the intensity of the jaundice. Lee and Vincent note that this delayed coagulation does not appear until five or six weeks after the onset of jaundice. The good effects of calcium treatment are felt after several days and the case is deemed safely operable when the calcium time reaches seven minutes. This time is estimated according to Lee and Vincent's technic: One cubic centimeter of the patient's blood is drawn into a sterile syringe previously rinsed with salt solution and expressed, without the needle, into a small tube containing 6 drops of a 0.5 per cent. calcium chloride solution. The tube is inverted every thirty seconds and the calcium time is taken at the point of coagulation. The test is the same as for coagulation time with the addition of calcium chloride. It has been found that too much as well as too little calcium will serve to delay the process of coagulation.

Blood platelets were isolated in such cases by Lee and Vincent and were found to act normally, both in the formation and retraction of the clot.

It has been found experimentally that bile has an inhibitory effect on the formation of thrombin. Bile will entirely prevent coagulation *in vitro* even in the presence of the optimum amount of calcium. It is probable, however, that bile never becomes so concentrated in the blood of jaundiced patients.

Gall-stone Formation.¹²⁶ Two theories have been developed in regard to gall-stone formation. A bacterial theory has been urged since 1886, when Gallipe first suggested the microbic origin of biliary calculi. Bernheim, Welch, Chiari, Gilbert and Domenici, Mignot, Milian and Hanot, Cushing, Halstead, Richardson and others, have contributed useful facts in this connection.¹²⁷

The bacterial theory of gall-stone formation, sponsored by Naunyn and his pupils, Jankau and Thomas, has dominated experimental work for many years.¹²⁸ Stated briefly, it is as follows: The cholesterin content of the bile is constant and independent of the blood and diet of cholesterin. The cholesterin of the bile does not result from the general metabolism and is no specific secretion product of the liver. The cholesterin in the bile is derived from the epithelium of the gall-bladder brought about by a "stein-bildende Katarrh," and is initiated by bacterial infection. Naunyn found that in catarrhal bronchitis the cholesterin content of the sputum was 0.9 per thousand, and in putrid bronchitis 1.5 per 1000 c.c. Naunyn assumed similarities in the pathological processes of catarrhal inflammations of all mucous membranes, attempted to show that an increased formation of cholesterin accompanies all of these inflammatory conditions and found in this conception the chief underlying factor in gall-stone formations. The presence of various

¹²⁵ Pettibone: Journal of Laboratory and Clinical Medicine, 1918, iii, 278.

¹²⁶ Rothschild and Wilensky: American Journal of the Medical Sciences, 1918, clvi, 239. Ibid., 1918, clvi, 404. Ibid., 1918, clvi, 564.

¹²⁷ Ibid., quoted by Rothschild and Wilensky.

¹²⁸ Ibid.

organisms in the centers of the stones, as well as in the gall-bladder wall, lent support to this hypothesis.

The recent work of Rosenow,¹²⁹ in the production of experimental cholecystitis by the injection of streptococci, is of much interest. In the examination of a large number of stones it is of special interest to point out that Rosenow obtained sterile cultures from four typical cholesterin stones, while in the mixed stones he obtained a variety of organisms. This lends rather strong support to the theory of the non-bacterial origin of pure cholesterin stones.

In the last four or five years the non-bacterial origin of gall-stone formation has received extensive attention from laboratory workers. Much of the work originated in the Freiburg school; and, perhaps, was stimulated and aided by the development of improved chemical methods which permitted a more accurate determination of the various metabolic functions. The mechanism of gall-stone formation is, undoubtedly, intimately bound up with the metabolism of the lipoids (cholesterin, lecithin, fats), and with the production and elimination of the bile pigments. Aschoff and Bacmeister were the first to point out that, morphologically, those gall-bladders, in which pure cholesterin stones were found, show, practically, no inflammatory reaction. On the basis of this and some experimental work they advocated the theory of an "aseptic cholelithiasis." Their experimental work was somewhat inconclusive; but since then much new work has been done to substantiate this theory, all of which is reviewed by Rothschild and Wilensky.¹²⁶ In the non-bacterial theory of gall-stone formation interest centers in the metabolism of cholesterin, and in the relationship of the latter to the bile, the blood and the food.

BILE. In normal bile the cholesterin content varies between 20 and 80 mg. per 100 c.c. (Rothschild). The bile is properly considered as a colloidal solution, the cholesterin being held in suspension by means of the bile salts, acids, fats and lecithin dissolved in the same. Such a compound mixture is subject to the ordinary physical and chemical laws. Precipitations of any of the ingredients may follow supersaturation or a disturbance of the normal equilibrium.

BLOOD. The cholesterin content of the blood in normal persons varies between 150 and 180 mg. per 100 c.c. of blood (Rothschild). The results of other workers are as follows: Chauffard, Laroche and Grigaut, 150 to 180 mg. per 100 c.c. blood; Widal, Weill and Laudat, 174 to 195 mg. per 100 c.c. blood; Bacmeister and Havers, 110 to 180 mg. per 100 c.c. blood.

THE RELATIONSHIP OF FOOD, BLOOD AND BILE. The question as to whether the cholesterin of the food is absorbed is of paramount importance. Divergent results have been obtained by different workers on account of the types of animals employed and because of the artificial conditions produced in the experiments. It has been, however, proved conclusively that the cholesterin of the food is absorbed and that an extensive feeding is followed by an increase in the cholesterin content of

¹²⁹ Rothschild and Wilensky: *American Journal of the Medical Sciences*, 1918 clvi, 239. *Ibid.*, 1918, clvi, 404. *Ibid.*, 1918, clvi, 564.

the blood; and that the cholesterin content of the blood must increase to a certain stage before any increase appears in the bile.

In studying a large number of cases of cholelithiasis, Wilensky and Rothschild¹²⁶ found that the cholesterin contents of the blood of the patients was a very variable finding. The figures obtained might be below, at, or above the normal, and the explanation for this marked variance is found in the conclusions of Wilensky and Rothschild, which are quoted verbatim.

In the mechanism of stone formation "the biological sequence of events may be one of three:

1. "The pure infections. The element of the cholesterin metabolism does not enter unless there is a complicating obstruction in the common bile duct. Only in that contingency does the cholesterin content of the blood range high. The complicating obstruction is due to swelling in the duct, or to inflammatory swellings, or adhesions about the duct. The affection begins as an empyema of the gall-bladder, and when repeated recrudescences of infection are permitted it terminates in a contracted and shrunken gall-bladder.

2. "The cases that have their origin in disturbances in the cholesterin metabolism. Most often these disturbances in function are initiated by the physiological changes which accompany pregnancy. The hypercholesterinemia of pregnancy may reach such a degree that the accompanying supersaturation of blood and bile is rectified to the normal by a precipitation of stones in some portion of the bile passages, almost always the gall-bladder. This immediately furnishes the explanation for the patients with normal gall-bladders containing stones, the cholesterin contents of whose bloods are normal. At some time previous to the observation there had occurred a hypercholesterinemia which had been restored to the normal by a precipitation of stones. No further hypercholesterinemic crisis having occurred, these patients have had symptoms due to the mechanical effects of the stones acting as foreign bodies and have submitted themselves to operation at this stage. It is to be expected that the cholesterin content of the blood of such patients would be normal at the time of operation. The original factor which had caused the hypercholesterinemia may continue, however, or may be repeated at intervals, so that at the time of observation the cholesterin content of the blood is relatively high.

3. "Combinations of infection and disturbed cholesterin metabolism may occur either simultaneously or alternately, and with different degrees of intensity. Depending on the factor which is paramount, or the stage of the process, or the presence or absence of complicating factors, which now become numerous, the cholesterin content of the blood is found to be below the normal, at the normal, or much above the normal range."

"The apparent discrepancies in the figures of the cholesterinemias are now explainable. This group represents the end-results of several other groups and the cholesterin content of the blood is found to vary as these do."

From the foregoing facts it must be conceded that in any given case

the diagnostic value of any determination of the cholesterol content of the blood is *nil*. This conclusion is corroborated by the observations of Reimann and Magoun.¹³⁰ The cholesterol content of the blood can also be normal under the following conditions:

1. "In the presence of stones in a normal gall-bladder, without common duct obstruction and with or without high temperatures.

2. "In the presence of a chronically inflamed gall-bladder containing stones without common duct obstruction and with or without high temperatures.

3. "In the presence of any of the above with incomplete obstruction of the common bile duct.

4. "In the presence of an empyema of the gall-bladder, with or without stones, with low or high temperatures and with no obstruction in the common duct.

5. "In conditions as in the preceding division, (4) with partial or complete obstruction of the common duct."

The finding of a hypercholesterinemic condition, while usually pointing to some disturbance in the cholesterol metabolism and in the bile passages, is always subject to correction in the presence of any complicating factor, which, by itself is capable of increasing the cholesterol content of the blood. And when this correction is to be made it becomes difficult, if not impossible, to decide whether the entire excess of the cholesterol in the blood above the normal is due wholly or only in part to these complicating factors. The situation becomes all the more complex when it is known that it is possible to obtain hypercholesterinemic figures in other diseased conditions.

The occurrence of a hypercholesterinemia can be used as a diagnostic factor only when a distinction must be made between jaundice due to cirrhosis of the liver and the jaundice due to common duct obstruction. A hypercholesterinemic condition indicates that obstruction is present.

The Effects of Bile Drainage and of Cholecystectomy and Cholecystostomy. A continuation of the studies of Wilensky and Rothschild¹²⁸ deals with these topics. With common duct drainage the body is rapidly depleted of its cholesterol. Gall-bladder drainage does not accomplish this extreme effect unless there is a concomitant obstruction in the common duct. After a certain minimum is reached, there is no further fall in the cholesterol content. The effect of the drainage *per se* upon the cholesterol metabolism is *nil*; only that portion of the cholesterol is removed which exceeds the normal minimal content.

"How thoroughly this depletion is accomplished depends upon the completeness or incompleteness of the biliary fistula, and, when this is complete, one may see the cholesterol content of the blood fall to values below the normal. The depleting effect of bile drainage may be enhanced or retarded by a lack or superabundance of lipid in the diet, and when a rapid depletion of cholesterol bodies is desirable it is of advantage to submit the patient to a lipid-free diet.

"The loss of bile produced by a biliary fistula has a deleterious effect

¹³⁰ Surgery, Gynecology and Obstetrics, 1918, xxvi, 282.

upon the animal body, and when this has lasted for an appreciable length of time; patients are liable to exhibit any or all of the following symptoms:

1. "Disturbance of the digestive function frequently accompanied by vomiting.

2. "Greater or lesser degrees of constipation induced by an absence of bile from the intestinal tract.

3. "Depreciation in the general well-being and vigor of the body and a deterioration in the patient's general condition, as evidenced by an impairment in the circulation, in a lessened resistance to bacterial or other trauma and in a general lassitude and muscular weakness.

"This deleterious effect may be counteracted or may be forestalled by collecting the biliary drainage and by feeding it, after filtration, to the patient by the stomach tube.

"The operation of cholecystectomy accomplishes two objects: (1) It removes the local focus of infection when that is present, and (2) it removes the reservoir of bile with its contained stones and stagnated bile. The latter removes a part of the end-product of the pathological disturbance in the cholesterol metabolism which has already taken place; the former removes an agent which has complicated this biological disturbance or which has initiated the stone formation. The only permanent effect is the removal of the infectious process whenever that is present."

Cholecystostomy accomplishes the following objects:

1. "It enables one to remove the end-products of disturbed metabolism somewhat better than by a cholecystectomy without drainage.

2. "It affords a surgical method, inferior to cholecystectomy, for draining the infected area. This does not guarantee that the source of infection has been removed and healing may take place before this source has completely disappeared. Recrudescences of infection may therefore be expected and do actually occur. However, there may be occasions when cholecystostomy would yield greater advantage both immediately and perhaps remotely, and when it is certain that no surgical contra-indication exists, such as a strictured or obliterated cystic duct, the procedure should be carried out in preference to cholecystectomy.

3. "It affords a method of biliary drainage. The competence of this method was indicated in the earlier part of this review and compared with common-duct drainage."

A critical consideration of these studies cannot help but bring out the following two points:

1. "In cholelithic gall-bladder conditions the proper interpretation of any cholesterolin determination is only possible after a knowledge is obtained of the actual anatomical conditions. Only then is one enabled to reason backward and deduce the natural history of the actual pathological disturbance which underlies the entire disease. Such knowledge then furnishes scientifically correct and adequate data upon which a rational method of treatment may be based.

2. "It becomes evident that a choice of the proper operation, effi-

ciently carried out, combined with the intelligent use of bile drainage, restores the individual patient to that condition of life and health when no hypercholesterinemic crisis had yet occurred, and when no bacterial infection of the bile passages had yet taken place. It becomes evident, too, that the cause of the hypercholesterinemia has been influenced in no way. More particularly it becomes apparent that when the primary factor at fault is a disturbance in the cholesterol metabolism the essential thing to accomplish is an adequate and prolonged bile drainage in order to deplete the body of the supersaturation of cholesterol; that when, as happens frequently, both of these causative factors are working hand in hand, both of these factors must be remedied by making use of both of the methods of treatment indicated herewith."

Hepatitis: A Constant Accompaniment of Cholecystitis. In 30 cases of biliary tract disease which had come to operation, Graham¹³¹ noticed a distinct enlargement of the liver in 26. In the remaining 4 cases there was definite gross evidence of previous or existing pathological change in the liver other than an enlargement. Pieces of liver tissue, excised during the operation, were examined bacteriologically and pathologically; the following conclusions were possible:

1. In cases of acute or subacute cholecystitis there was constantly found microscopical evidence of inflammation, characterized by leukocytic infiltration of the interlobular, or periportal sheaths; in the more severe types, the infiltration extended to the peripheries of the lobules, and were associated with edema, slight necrosis and moderate fatty degeneration. Cultures from the liver tissue and from the gall-bladder contents usually revealed identical organisms.

2. In chronic cholecystitis the liver often presents a picture practically identical with that of an early cirrhosis, even when there had never been any stasis of bile. The inflammatory reaction appears to be, chiefly, a pericholangitis. The gross enlargement of the liver is probably due mostly to edema. The enlargement of the liver in Graham's cases always diminished markedly or returned to normal size after appropriate surgical treatment.

Prognosis of Gall-bladder Infections. Gibbon¹³² believes that the mortality in gall-bladder infections depends very largely on whether or not a cholangitis is present. A patient having undoubted symptoms of gall-bladder infection should not be allowed to postpone operation, even though it is known that far-advanced and neglected cases of disease of the gall-bladder alone give good results after operation. Jaundice due to stone in the common duct, in the absence of symptoms of sepsis, is not necessarily a grave condition if operation is promptly done; but a persistent jaundice accompanied by general symptoms of sepsis is a matter of great importance and calls for prompt drainage through the gall-bladder, through the common duct, or through both.

The high mortality following gall-bladder operations occurs in the cases with long-standing symptoms, with acute exacerbations of infection, and in cases of malignancy. The use of horse serum has practically

¹³¹ Surgery, Gynecology and Obstetrics, 1918, xxvi, 521.

¹³² American Journal of the Medical Sciences, 1918, clv, 644.

eliminated the danger of hemorrhage due to long-standing jaundice. (This latter opinion is not universal.—Reviewer.)

The Gall-bladder and Bile Ducts. A general survey of the surgery of the gall-bladder and bile ducts is given by Judd.¹³³ The contention that infection enters this region much more often by way of the general circulation than was formerly believed, is supported by the results of experimental work, and also by the fact that infections in this tract are, in many instances, only a part of a larger process, as is frequently shown by the presence of concomitant lesions in the appendix, the duodenum, and the stomach. Whether the infection is primary in any one of these foci and from it distributed to the other regions, or whether infection begins at the same time at the different points, cannot be definitely decided. It is, however, immaterial from a practical point of view, inasmuch as the surgical procedure for biliary tract lesions will usually involve exploration of these other areas, and the correction of any demonstrable lesion.

Undoubtedly, the entrance of infection is sometimes through the portal circulation and, in such cases, infection exists within the liver itself. Infection persisting in the liver may, in some instances, be the cause of a recurrence of symptoms at subsequent periods. The formation of calculi, in Judd's opinion, is usually the result of bacterial infection, and apparently takes place most commonly in the gall-bladder, or extrahepatic ducts, or, extraordinarily, in the intrahepatic ducts.

Judd distinguishes the following clinical groups:

GROUP 1. In this group are cases of a more or less chronic cholecystitis with symptoms of dyspepsia acting at times as foci for a more or less general infection. The clinical histories of the cases in this group are not definite. Most intensive study is necessary before treatment can be recommended.

In many instances, the cholecystitis is undoubtedly a forerunner of the formation of calculi, although in a definite percentage of the cases the cholecystitis remains a separate entity without showing any evidence of stone formation. Gangrene and perforation of the gall-bladder may occur without any evidence of calculi.

At the time of exploration, Judd sometimes finds it difficult to make out the pathological conditions in the gall-bladder, even when the clinical features are very definite, as the gall-bladder may appear quite normal. A considerable enlargement of the regional lymphatics sometimes helps in making a diagnosis. These lymphatics are always greatly enlarged and softened in the presence of a marked cholecystitis. If all other possible lesions have been excluded and the clinical syndrome is positive, it may be necessary, in Judd's opinion, occasionally to remove what seems to be a fairly good gall-bladder. Drainage of the gall-bladder in such cases is not sufficient. In most instances the symptoms are relieved for a time after drainage, but there is a recurrence of symptoms in too large a number of the latter cases, as might be expected from the nature of the trouble, so that removal of the gall-bladder is indicated in all cases of cholecystitis.

¹³³ Journal of the American Medical Association, 1918, lxxi, 79.

GROUP 2. The second group of cases includes those patients having typical attacks of gall-stone colic. On exploration, a gall-bladder, apparently normal in size, color and thickness, and containing one or many stones, may be found; or in addition to the stones, any degree of inflammation may coexist in the gall-bladder. In this group the clinical features and pathological conditions are definite, and removal of the gall-bladder is indicated.

Judd found that the largest number of the recurrences of symptoms occurred in this group. The symptomless intervals have extended to six years. The first operation in most of these cases had been drainage of the gall-bladder, and the recurring symptoms were almost always due to stones in the gall-bladder which had either been overlooked or had reformed after the first operation. There is a great deal of evidence to show that stones often do reform in the gall-bladder. In most cases such gall-bladders are probably functionless after the first operation, and patients are quite as comfortable without their gall-bladders as with them.

GROUP 3. In this group are the cases of typical cholangitis with stones in the common duct which produce periods of obstruction to the flow of bile and a resulting jaundice. Each attack is associated with chills and fever. Stones may also be present in the gall-bladder, in the cystic and in the hepatic ducts; and frequently there is swelling and hardening of the pancreas. It is usually best in these cases to remove the gall-bladder after the common duct has been cleared and the drainage has been provided.

GROUP 4. In group 4 are the atypical cholangitis cases with painless or almost painless jaundice. Judd believes it is quite impossible to make a definite diagnosis before exploration in a large percentage of these cases, and in view of this fact, whenever there is much uncertainty about the diagnosis, an exploration is indicated. The symptoms may be produced by biliary cirrhosis or by malignant disease at the ampulla or in the head of the pancreas, or by an inflammatory hardening in the head of the pancreas (rare). Any variation in the intensity of the jaundice or any suggestion of fever or chills is regarded as an indication for an exploration.

Operation in these cases may be very difficult, and the patient may be in none too good a condition. The greatest difficulty arises usually from oozing and hemorrhage, which may come from the wound or possibly from the mucous membrane of the nose, the throat, or the intestinal tract, and which may begin at any time up to eight or ten days after the operation. As a general rule, if the coagulation time is more than from twelve to fifteen minutes, the risk from an operative procedure will be very great. The use of calcium salts before or after operation has not been of distinct advantage in Judd's experience, but he lays great emphasis on the advisability of transfusing all patients with jaundice before operation, since, to accomplish the most good, the transfusions must be made before any oozing begins.

For oozing which does start from the wound or from the mucous membranes, any time after the operation, Judd recommends aspiration

of the congested liver with a large trocar or even opening well into the liver substance. The bleeding from the wound in the liver is very profuse, and Judd considers this probably the way in which the benefit is derived. If the bile flowing from the tube in the common duct stops or is greatly reduced, it is almost certain to mean that oozing will take place, while, on the other hand, if drainage continues, there is not this danger of oozing. The oozing seems to depend directly upon the capacity of the liver cells to functionate. In these cases, naturally, the liver cells are greatly congested and swollen, so they cannot secrete unless the pressure and swelling are relieved; the relief is afforded through the incisions into the liver. Frequently the bile begins to flow very soon after this procedure. The common duct drainage tube should be left in place a long time.

The most desperate cases are those in which the obstruction of the common duct is due to a stricture, or in which the duct has formerly been ligated, or divided, during an operation. Such cases are becoming common because of the more frequent performance of cholecystectomy. The jaundice is generally complete, and no bile passes into the intestinal tract. The period of closure continues from several months to a year or more, and the difficulty lies in reestablishing liver function after the duct has been reconstructed. The jaundice often persists in spite of bile drainage, and almost any type of toxemia may appear. Transfusion of blood and aspiration of the large congested liver may be very useful.

Recurrences after Biliary Operation. Judd and Harrington¹³⁴ studied the histories of the patients operated upon at the Mayo Clinic for recurrence of symptoms after biliary operations, and have come to the following conclusions. The removal of the gall-bladder at the primary operation reduces the risk of later trouble. It is not necessary to open and probe the common duct at every gall-bladder operation. Infection in the liver, gall-bladder, or ducts is the most frequent cause of secondary trouble, and may recur many years after the primary operation. The recurrence of stones is more frequent in the gall-bladder than in other parts of the duct system; the common duct is next in point of frequency. In a small percentage, stones can be overlooked in the common duct; in other cases, the stones reform.

Reconstruction of the Common Bile Duct. Since excision of the gall-bladder has become a frequent practice, Horsley¹³⁵ states that the possibilities for injuring the common bile duct, particularly in inexperienced hands, have become multiplied. Defects in the common bile duct may result from errors in operative technic, from strictures following ulceration or trauma, or from neoplasms. A number of methods have been described for reconstructing the common bile duct, and Eliot¹³⁶ has given the recent literature laying particular stress on the work of European authorities.

Lewis and Davis¹³⁶ have used fascia, transplanted from the abdominal wall, to repair defects in the common bile duct of dogs. Stropeni and

¹³⁴ Journal of the American Medical Association, 1918, lxx, 1500.

¹³⁵ Ibid., lxxi, 1188.

¹³⁶ Ibid., quoted by Horsley.

Giacinto reported experiments in which a portion of a vein was used to fill a defect in the common duct. Walton,¹³⁶ in reviewing bile duct surgery described an operation in which he uses a duodenal flap.

Moynihan¹³⁶ suggested the use of the jejunum in the same manner as in the Y-gastro-enterostomy of Roux. The upper part of the jejunum is cut across and the proximal (oral) end is sutured end-to-side about 12 inches below the distal end. The distal end is then anastomosed to the gall-bladder. Clinically, if the gall-bladder were normal the ordinary cholecystenterostomy would serve the purpose, so that practically Moynihan's operation would be useful or necessary only where the end of the bowel must be attached to a small contracted gall-bladder, or possibly to the stump of the hepatic duct. Horsley has done Moynihan's operation six times in dogs, and all of the animals died.

Horsley¹³⁶ attempted to reconstruct the common duct by utilizing a segment of transplanted vein which had been turned inside out. While technically possible, the final results were unsatisfactory.

The Sullivan¹³⁶ operation—in which a rubber tube is sutured into the stump of the common or hepatic duct, carried into the duodenum and surrounded by the neighboring tissue and the omentum—results in a biliary fistulous tract, probably similar in general construction to an external biliary fistula that follows removal of the drainage tube after an operation that opens the bile tract. Two dangers militate against a permanent satisfactory result of the Sullivan operation: (a) Stenosis of the new formed duct by cicatrization; (b) stone formation and ascending infection of the bile passages.

The danger of cicatricial stenosis may be minimized by keeping the tube in the newly-formed duct sufficiently long to allow complete epithelialization and thorough establishment of the newly formed duct. This period depends upon the extent of the gap to be bridged (Hagler).

It has been asserted that in an operation of the type of the Sullivan operation, the epithelium from the stump of the duct would grow over the tract made by the tube and so prevent contraction. This does not, however, seem to be true. In experimental work, Horsley¹³⁶ found that unless the surrounding tissues had some immunity to the effects of the irritating discharge with which it is constantly bathed for a long time, inflammatory infiltration and contraction took place. In this respect the Sullivan operation, which utilizes the neighboring tissues, may be less liable to be followed by contraction than when tissue is transplanted from a distance, though the immunity of the tissues outside the duct itself, even when in close proximity to the duct, would probably not be very great.

Hagler¹³⁷ states that calculus formation and infection of the biliary passages may be guarded in a measure by: (a) Avoiding non-absorbable sutures; (b) not allowing the tube to remain permanently. If the tube does not pass at the proper period it should be removed by operation. Both spontaneous passage and operative removal may be facilitated by allowing the tube to project a few inches into the duodenum. A T-tube

which can be removed at will without operation may be superior to the tube as employed by Sullivan. (c) Formation, if possible, of a valvular opening into the duodenum.

It seems that the most satisfactory reconstruction occurs when the stump of the common or hepatic duct is sutured to the mobilized mucosa and submucosa of the duodenum. In this way epithelial and sub-epithelial layers of tissue that are accustomed to the biliary discharges are employed. If an accurate approximation is made, the submucosa of the duodenum unites with the corresponding tissue of the stump of the duct, and no more contraction should occur than would take place after suturing a wound in the intestine. William J. Mayo¹³⁶ and Le Grand Guerry¹³⁶ employed such a technic. In Mayo's operation the duodenum is mobilized and displaced upward so that an anastomosis can be made with the divided hepatic or common duct. In the operation of Le Grand Guerry only the submucosa and mucosa of the duodenum is liberated and mobilized until it alone can be sutured to the duct wall; but in certain of the cases the duodenum also must be mobilized. Both of these types of operation accomplish the same purpose; they yield a fistula continuously lined by epithelium and fibrous structures accustomed to the constant passage of irritating bile.

Obstructive (Malignant) Jaundice. Erdmann¹³⁸ enumerates the indications for operation in obstruction to the flow of bile incident to malignant disease, or irremovable tumors, about the terminal portion of the common and pancreatic ducts:

1. Possible mistaken diagnosis.
2. The relief of distress due to pain (back pressure upon the biliary system). Some patients complain of this symptom only.
3. Pruritus of an untractable degree or nature.
4. Social or business reasons. "To prolong life in comparative comfort; to give the patient relief from his jaundice and pruritus so that he may live with his family or conduct his business until such time as death takes place from metastasis, exhaustion, etc."
5. Surgical euthanasia: The primary operative mortality in these conditions will be high, but considering the absolutely hopeless outlook, together with the urgent demand for relief, one is warranted in selecting an operative procedure. (This indication is perhaps subject to argument.—Reviewer.)

The most frequent cause of obstructive jaundice is carcinoma of the pancreas, ampulla of Vater, or duodenum. Cancer of the duodenum represents about 0.4 per cent. of all carcinomas, and of these about 70 per cent. are of the ampulla of Vater. Pancreatic cancer is the most fatal of any form of carcinoma; death ensues from seven to eight months from the onset of noticeable symptoms and occurs before metastases obtain any great extension. Excisions of growths at the ampulla have been rare and the results are not encouraging. Of 22 such cases reported up to about November, 1915, 8 primary and 5 subsequent deaths occurred. Of 5 surviving any length of time, 2 were well at seven months, 1 ten months, 1 two years, and 1 at three and three-quarters years.

The simplest palliative operation—cholecystostomy—is not satisfactory, as the operation, through loss of biliary salts and body fluids, including the pancreatic juices in some patients, is likely to be followed by a rapid demise.

The choice of operation depends upon a number of factors: (1) Physiological efficiency; (2) ease of accomplishment; (3) immunity from ascending infection; (4) effects immediate and remote on the patient's metabolism. Cholecystoduodenostomy will more nearly simulate the normal or rational condition of biliary drainage. Owing to the fixity of the duodenum in many patients this operation is accompanied with a greater mortality than a cholecystogastrostomy. The operation of cholecystogastrostomy was performed by Moynihan 21 times; 20 patients recovered from the operation and lived for several months or years, without suffering disability which could be attributed to the entrance of the bile into the stomach. Erdmann's experience with this operation bears out the above. Cholecystenterostomy, and cholecystocolostomy can also be done but the best results are obtained with cholecystogastrostomy. Physiologically, no objection to the presence of bile in the stomach has been demonstrated.

THE PANCREAS.

Effect of Bile Drainage on Subacute and Chronic Pancreatitis. The object of Archibald's¹³⁹ investigation was to discover the effect of bile drainage on inflammatory swellings of the pancreas in such patients as recovered and regained some of their previous health. The only criterion of judgment available in all but one or two of the patients was the recurrence or the absence of symptoms.

While it is perhaps not quite justifiable to draw any far-reaching conclusions on the basis of the rather small series of cases studied, and in view of the lack of exact knowledge of the anatomical condition of the gland, the results recorded are suggestive. The general fact stands out clearly enough that, the shorter the time of drainage of bile, the more likely were symptoms to persist similar to those complained of before operation; and that when the length of time of drainage was prolonged for four weeks or more, the patients were cured permanently. Whether gall-stones were present or not, did not seem to make any difference.

In the discussion which followed the reading of Archibald's paper, Judd,¹⁴⁰ of Rochester, spoke of the experiences of the Mayo Clinic. The original form of treatment for inflammatory indurations of the pancreas had been drainage of the gall-bladder; and sometimes it had been necessary to repeat this operation several times. Quite by accident a cholecystectomy was done for one case, and this patient having made a prompt and permanent recovery, the latter treatment was repeated. W. J. Mayo had called attention to the fact that when a pancreatitis was associated with a gall-bladder condition, clinical experience had shown that cholecystectomy was a good operation.

¹³⁹ Journal of the American Medical Association, 1918, lxxi, 798.

¹⁴⁰ Ibid., discussion.

The experimental work which was done on pancreatitis at the Mayo Clinic, Rochester, yielded observations somewhat different from those of Archibald, but, nevertheless, Judd remarked that the conclusions seemed to be the same. The assumption was that the pancreatitis was caused by bile entering the pancreatic duct, owing to some action on the sphincter. For this reason, Archibald proposed to cure pancreatitis by paralyzing the sphincter.

Unless there is a definite mechanical obstruction in the common duct, cholecystenterostomy is useless. Permanent bile drainage cannot be established in that way. The reason it is believed that cholecystectomy is a better procedure in pancreatitis is that in every case in which the gall-bladder is removed, the common duct dilates until its increased capacity compensates for the loss of the gall-bladder, and the sphincter becomes incontinent. In the experimental work of removing the gall-bladder, conducted by Mann,¹⁴¹ it was found that a definite enlargement in the common duct took place. This seemed to be due to fluctuation in pressure. The resistance offered by the liver itself was greater than that offered by the wall of the extra hepatic ducts or the sphincter. Judd presumed that this fluctuation in pressure eventually brought about what Archibald was doing in experimental work on the sphincter. It seemed that the dilatation in the duct continued until there was enough hypertrophy in the wall to overcome the resistance offered by the little sphincter in the ampulla. When that took place there was a paralysis of the Oddi sphincter and a continuous entrance of bile into the duodenum. This explained how removal of the gall-bladder might possibly cure cases of pancreatitis.

THE SPLEEN.

Rupture of the Spleen. Nystrom¹⁴² had 3 cases of rupture of the spleen in which paresis intestinalis occurred as a complication. This seems to be a rather frequent complication of splenic ruptures.

Nystrom worked out a new method on cadavers for controlling hemorrhage for the spleen. He ties a ligature around the pedicle and others like barrel staves around the spleen, which are held firmly in place by being tied at right angles to the one around the pedicle. All this can be prepared before operation so that it will fit like a bag over the spleen. The only tying then necessary is that of the stout ligature around the spleen pedicle. Possibly a tampon could be held in place by rubber bands around the spleen and a silk thread could let one pull on the bands just enough to cut them when necessary.

Infarction of the Entire Spleen. Nuzum¹⁴³ has compiled the available knowledge regarding total infarction of the spleen. Whenever this accident occurs, marked enlargement of the organ follows, the weight of the spleen varying from 300 to 1300 gms. The symptoms are pain, tender-

¹⁴¹ Journal of the American Medical Association, 1918, lxxi, 798, quoted by Judd.

¹⁴² Upsala Lajareforenings, Forhandlingar, 1917, xxii, 221 (Abst., Journal of the American Medical Association).

¹⁴³ Journal of the American Medical Association, 1918, lxx, 282.

ness in the left hypochondrium, enlargement of the organ, occasionally fever, and vomiting of blood due to rupture of dilated gastric veins.

The etiological factors are those causing a vascular obliteration and include: (1) Pressure on the walls of the splenic vessels by tumors; (2) torsion of these vessels in instances of ectopic spleen; (3) thrombosis; (4) embolism. The emboli may be: (1) Exogenous, including bacteria, and (2) endogenous, as atheromatous plaques.

An occlusion of either the splenic artery or vein is sufficient to produce total infarction of the organ. Thrombosis of the vein was the causative factor in 9 instances recorded in the literature. Arterial plugging was responsible in 5; this is, however, exceptional since an embolus lodging in the splenic artery only rarely gives rise to total infarction, in spite of the fact that the artery is an end vessel. Simultaneous occlusion of both of the vessels is apt to result in immediate necrosis of the entire spleen, and a fatal outcome may follow from absorption of the toxins.

Similar conclusions have been drawn from experiments. Carriere and Vanverts¹⁴⁴ ligated both vessels in dogs and rabbits, and found that in most instances gangrene resulted, the organ becoming a pus sac. After ligation of the splenic artery alone, gangrene did not result. They concluded that since the circulation was not completely interfered with, the spleen cells were able to take care of bacteria without pus formation.

Diagnostic Tests for Disturbances of Splenic Function. Krumbhaar¹⁴⁵ describes a number of methods available for estimating the disturbance of splenic function, and of the ability of the body to compensate therefor. These have to do especially with the amount of blood destruction and with the evidences of blood regeneration; and are especially valuable in that a quantitative estimation can be attempted. The tests referred to may be considered under the following heads:

1. Resistance of erythrocytes. This is ordinarily known as the "fragility test."
2. Evidences of bone-marrow activity (reticulated cells; nucleated forms; platelets).
3. Agglutinins and hemolysins in the blood serum.
4. Urobilin excretion.
5. Protein, uric acid and iron metabolism.

In actual conditions, Krumbhaar considers these tests invaluable both for diagnosis and, especially, for prognosis.

Splenectomy in Splenomegalies. Hitzrot¹⁴⁶ enumerates the conditions in which splenomegaly occurs:

1. Splenomegaly in infectious diseases (typhoid, malaria, ulcerative endocarditis, etc.).
2. Splenomegaly due to chronic venous congestion as a result of cardiac or pulmonary disease.
3. Splenomegaly in amyloid disease.
4. Splenomegaly in syphilis and malaria are rarely surgical conditions.
5. Splenomegaly in cirrhosis of the liver: (a) Biliary cirrhosis (Hanot

¹⁴⁴ Journal of the American Medical Association, 1918, lxx, 282, quoted by Nuzum.

¹⁴⁵ The Spleen and Anemia, Philadelphia, 1918.

¹⁴⁶ Annals of Surgery, 1918, lxxvii, 540.

type) including the metasplénomegalic form of the French in which the enlargement of the spleen precedes that of the liver and is relatively greater. (b) portal cirrhosis—alcoholic and other forms; (c) the luetic cirrhoses; (d) congenital obliteration of the bile-ducts with cirrhosis and splénomegaly. In all of the above, Hitzrot considers that the coincident disease of the liver renders it unlikely that any operation directed toward the spleen would offer any benefit. (This opinion differs from the experience of the Mayos referred to last year.—Reviewer.)

6. Splenic anemia: (a) Splenic anemia of childhood—Von Jaksch, (b) Banti's disease (including Egyptian splénomegaly). In these splenectomy, in properly selected cases, is an essential therapeutic measure, and yields gratifying results.

7. Hematogenous jaundice of the familial type. Splenectomy yields a cure in these cases.

8. Pernicious anemia. In certain groups splenectomy has been found, empirically, to be of value; but more accurate knowledge is desirable of the various types, in order to make a proper selection possible.

Pacini¹⁴⁷ adds several other conditions. According to him splenectomy is indicated in (1) Banti's disease in its early stages; (2) Griesinger's disease; (3) Minkowsky-Chauffard and Hayem-Widal jaundice; (4) primary splenic tuberculosis; (5) splenic syphilis, after medication fails; (6) malarial splénomegaly. Splenectomy is of questionable benefit in (7) splenic infantile anemia; (8) pernicious anemia, and (9) Gaucher's splénomegaly. Splenectomy is contra-indicated in (10) leukemic or pseudoleukemic splénomegaly, and in (11) the splénomegaly of kala-azar.

MORTALITY OF SPLENECTOMY. The mortality of splenectomy for chronic splénomegalic jaundice is 10 per cent.; and, omitting the dubious cases, only 7 per cent. (Chabrol and Bernard¹⁴⁸). In Banti's disease the mortality averages 14 to 16 per cent.; before 1900 it was 44.4 and 31 per cent.; and Chabrol and Bernard cite American statistics that have brought it as low as 9.6 per cent. In a series of 14 cases in which Sherren¹⁴⁹ performed splenectomy only 1 case—an advanced cirrhosis of the liver—was lost. The cases were distributed as follows: Splenic anemia and Banti's disease, 9 cases; Gaucher's splénomegaly, 1 case; hydatid cyst, 1 case, and splénomegalic jaundice, 2 cases. Krumbhaar,¹⁴⁵ quoting Herrman, Roth and Bernstein¹⁵⁰ records that splenectomy has been done for Gaucher's splénomegaly nine times; three of these resulted fatally. Veeder¹⁵¹ had a tenth case which recovered.

THE EFFECTS OF SPLENECTOMY. Pearce¹⁴⁵ describes the phenomena which are seen to follow splenectomy:

1. An anemia of the secondary type. This is either mild or moderate in severity; reaches its maximum at about the sixth week after the operation, and is followed by a period of repair which lasts a considerable time. The anemia may be irregular in character but usually has a very

¹⁴⁷ *Annals of Surgery*, 1918, lxvii, 299.

¹⁴⁸ *Paris Médicale*, 1918, 8.

¹⁴⁹ *Annals of Surgery*, 1918, lxviii, 379.

¹⁵⁰ *Archives of Pediatrics*, 1914, xxxi, 340.

¹⁵¹ Quoted by Krumbhaar: *Ibid*.

definite course. A definite leukocytosis appears also immediately, lasts for a few days, and is followed by a gradual regression. The amount of iron furnished in the food has no influence on the anemia, but it has been noted that cooked food tends to exaggerate the poverty of the blood. In humans the degree of the anemia following splenectomy for a diseased condition (injury, etc.) not involving disturbance of splenic function, is much milder than in animals.

2. An increased resistance of the red blood cells to various hemolytic agents (hypotonic salt solution, hemolytic serum, saponin, cobra venom, and mechanical shaking). The phenomenon has been observed also by Bottazzi, Banti, Vast, Pugliese, Luzzatti and Joannovics in dogs; by Gabbi in the guinea-pig; by Domenicci in the rabbit. The exact reason for this change is not evident; its association, however, with anemia and repair, and the presence of young and more resistant cells is very suggestive.

3. A lessened tendency to hemoglobinuria and jaundice and sometimes an absence of jaundice after the exhibition of hemolytic agents.

To these the following can be added:

4. An increase in the total fat and cholesterin of the blood of splenectomized dogs, which gradually decreases and returns to normal (Eppinger¹⁵²). The work of King¹⁵³ and of other workers confirms this observation. Pearce could not substantiate this finding in his own work; but inasmuch as all the other workers did find the increase in the lipid content, one is rather inclined to accept the majority view.

5. A transient decrease of the antitryptic and bactericidal properties of the blood serum. The agglutinins and opsonins remain unaltered (Bucalossi¹⁵⁴).

Ligation of the Splenic Artery for Banti's Disease. The following conclusions are drawn by Blain¹⁵⁵ from his experimental work: If strict asepsis (or antisepsis) is observed the operation of ligation of the artery or veins of the normal spleen in dogs can be carried out without mortality. Both Blain and Jamieson noted in their experiments that in the dogs which recovered, the omentum was firmly wrapped about the spleen.

In Blain's experiments the artery alone, the veins alone (at a considerable distance from the spleen), the arteries and veins and a part of the arteries were ligated. Uniform results were demonstrated at secondary operations; an atrophied organ was found massed in the omentum, except in the cases in which some of the arteries alone were ligated, when areas of local atrophy alone were found in the organ. The result in all of the experimental operations was apparently an atrophy rather than a necrosis. Blain believes that the former might be secured in the human subject in a fairly small spleen, especially if it were enveloped in omentum. Some of the dogs survived the second operation of removal of the atrophied organ and omental covering.

The successful conclusion of the one human case and the experimental

¹⁵² Quoted by Hitzrot: *Ibid.*

¹⁵³ Quoted by Pearce.

¹⁵⁴ *Ibid.*

¹⁵⁵ *Surgery, Gynecology and Obstetrics*, 1918, xxvi, 660.

work on animals are not sufficient as yet to admit the operation as one to be recommended. The operation will probably never supplant splenectomy, even though the latter still has a large mortality in the hands of most surgeons. Ligations of the artery may be indicated and may prove to be a safer procedure in selected cases.

THE SUPRARENALS.

War Suprarenal Insufficiency. Charles¹⁵⁶ has within the last year encountered 15 cases in men on active service of a complex resembling Addison's disease. The affection displayed a tendency to spontaneous subsidence, even in the apparently gravest cases. A few weeks of rest and quiet, abstention from meat, and treatment with suprarenal extract soon banished all the symptoms. In 2 of the cases there was what Loeper has described as suprarenal dyspepsia, notably improved by epinephrin. The symptoms developed in all after a period of exhausting fatigue, an infectious disease, or gassing. The asthenia was the most striking symptom, more mental than physical. For months the men were incapable of reading a paper, writing a letter or even answering questions that required any thought. Improvement in this respect was rapid under epinephrin treatment. The blood pressure was low, but this is common among all men at the front. A certain tendency to bronzing of the skin was perceptible in all the 15 cases. The suprarenal glands after recovery are left below par, and resumption of active service is extremely likely to re-arouse the old trouble, which at subsequent times might prove grave beyond recuperation.

¹⁵⁶ Journal de Medecine de Bordeaux, July, 1918.

GYNECOLOGY.

By JOHN G. CLARK, M.D.

CANCER OF THE UTERUS

The Cancer Problem.—The past year has not witnessed any great advances in the many problems connected with the etiology and the treatment of cancer in its various forms and manifestations, because research workers everywhere have been pre-occupied with the great problems of the war. But now that we are turning our attention once more to the problems of civil life, we hope results will soon be forthcoming which will add much to our knowledge of this most baffling condition. It cannot come too soon, since it is estimated that the increase in cancer in the United States during recent years is $2\frac{1}{2}$ per cent. per annum. However, through the greater skill in the application of radium and x -rays, and through the many improvements in operative technic and more careful selection of cases, much is being done to ameliorate, if not to cure, these very grave conditions. But in cancer, as in all other diseases, we are endeavoring to discover the precise cause, so that we may not only ameliorate and occasionally cure, but also that we may be able to prevent its occurrence absolutely.

A rather unique theory as to the origin of cancer has been brought forth by Shirlaw,¹ who believes that cancer always grows at the site of some irritation, thermal, mechanical or chemical in nature. One of the groups of substances liberated by all retrograde metamorphoses is nitrogen. This liberation, Shirlaw postulates, brings about an increased instability of the protoplasm of adjacent cells, and hence their more rapid proliferation. The fact that, as a rule, cancer occurs after middle life, when the glands of the body whose function it is to control metabolism and nitrogen excretion are undergoing decay, leads to the conclusion that cancer, which is essentially a rapid proliferation of epithelial cells, may be due to a defective elimination of nitrogen. The spleen, liver and lymph glands are the structures most important in controlling this nitrogen elimination. When the functional activities of the spleen and lymphatics begin to fail, there is an accumulation of nitrogen in the blood and tissues. This may result in the growth and division of cells. Moreover, cancer generally appears in tissues formed of highly compounded nitrogen molecules. On the basis of these arguments, Shirlaw recommends the administration of the extract of spleen or lymph nodes or the combinations of the two. He has made use of this

¹ Practitioner, 1918, c, 269.

treatment in a case of duodenal carcinoma with excellent results. He does not consider this a proof of success in all cases, but offers it as a suggestion.

Lewisohn² has recently been experimenting on the *effects of emetine in cancer*, as a further indication of the amebic nature of malignant growths. Its use is based on the question of the parasitic origin of malignant tumors, the specification of emetine in amebic dysentery and reports of successful treatment of skin cancer by the local use of emetine. Lewisohn's investigations, which were carried out in rats and mice in which carcinoma or sarcoma had been produced, led him to the following conclusions: (1) Injection of emetine into the neoplasm may cause its complete macroscopic disappearance. This is due, not to the specific action of the drug on the tumor cells, but to its purely caustic action. (2) Repeated intravenous injections did not affect the growth of tumors. Therefore, emetine has no specific effect on growth of malignant tumors. (3) His experiments therefore do not support the theory of the amebic nature of malignant tumors.

According to Robinson,³ the active cause of cancer, excluding trauma and bacteria, is the excessive use of sodium chloride. He therefore suggests that potassium nitrate be used in the treatment of cancer, since nitrates do not limit the reduction of the fluid below a certain level by offering osmotic resistance as sulphates do, and also act to displace the sodium and the chlorides. The doses should be minute and administered in high dilution. He feels this drug should be given a trial.

RADIUM IN CANCER. Last year, Levin and Joseph⁴ reported the results of their investigations on the effect of radium and roentgen rays on cancer cells, by which they showed that radium may deeply impair the proliferating power and consequently the clinical malignancy of cancer cells without producing any change in the morphological appearance of the tumor. The first effect of the rays on a malignant tumor is the inhibition of the proliferating power, in sterilization, as it were, of the cancer cells, the degeneration and destruction of the cancer cells and the formation of the sclerotic connective tissue taking place subsequently under the influence of the rays. In a further recent series of investigations by Levin and Levine⁵ in the Department of Cancer Research at the Montefiore Hospital, the above theories were further corroborated. The morphological appearance of radiated tumor tissue is not an absolute criterion of the therapeutic effect produced by the action of the rays on the tumor. While complete destruction of the tumor cells presents the most perfect result of radiotherapy, nevertheless, negative morphological findings do not preclude the possibility that the tumor was influenced by the rays. In a series of 20 cases of carcinoma of the rectum which is being prepared for publication *in extenso* by the senior author, the following observation was made: In

² Journal of the American Medical Association, 1918, lxx, 9.

³ Medical Record, 1918, xciii, 764.

⁴ PROGRESSIVE MEDICINE, June, 1918, p. 163.

⁵ Annals of Surgery, 1918, lxxvii, 442.

the cases in which an attempt at a radical operation was made the condition recurred with greater rapidity and malignancy than in those cases in which there was no operation done and only radium and roentgen-ray treatment given or an exploratory operation performed followed by radiations. Similar observations could be made by any surgeon with a large cancer material. Thus, pre- and post-operative radiations of cancer as a method of inhibiting the proliferating power and the consequent clinical malignancy of the tumor cells is of undoubted value and presents no danger.

PERSONAL VIEWS. The lapse of time since we began the use of radium for cancer of the female genital organs does not permit us as yet to regard it as an approved curative remedy, for our period of observation has extended over only three years, and the five-year test has not been passed. While, therefore, we must hold in abeyance any forecast as to ultimate results, the series of 100 cases treated in my⁶ clinic nevertheless justifies us in estimating with great assurance the excellent palliative effects of radium. Before the advent of radium in the treatment of cancer of the cervix, we were constantly passing in clinical review large numbers of cases, among which only the occasional one was amenable to surgical measures; the others, upon being classed as inoperable, dropped into the hopeless discard and frequently did not appear even in our card indexes. A very few only of the latter class ever reached the hospital ward, for beds could not be utilized for this hopeless class of patients. Because of this casual treatment of these patients, we did not realize the extraordinarily large disproportion between the operable and inoperable cases, and in former years I offered my small series of radical operations for cervical cancer with a puzzled query, for if cancer was so frequent as was constantly asserted, why was not a larger number of operable cases being admitted to our wards?

In view of our more recent experience the answer comes with overwhelming force, and a surgical optimism, never enthusiastic, is now reduced to even a lower degree in the face of these discouraging figures, for while by the more radical method we operated upon only about 60 cases in ten years, or an average of about 6 annually, we now estimate that we were turning away during the same decade at least 300 as hopeless. A basis for this assertion is laid upon the statement that during the last three years we have refused no patient, regardless of the extent of growth, and giving all the possible benefits of radium, 100 having been admitted to the hospital. Combined operative statistics show that even in the selected cases for a radical hysterectomy, the primary surgical mortality will seldom fall below 10 per cent.; that the disabling sequelæ are numerous and serious, and that in the end, under average skill, at least 66 $\frac{2}{3}$ per cent. will die from a recurrence. We have, therefore, no reason to boast of epoch-making strides in the surgery of cancer of the uterus. Because this minimum salvage is the best that has been obtained by any other means of treatment, we still strongly adhere to

⁶ Surgery, Gynecology and Obstetrics, 1918, p. 619.

the dictum that when the case is within surgical bounds, it should be treated with radical surgical measures. However, the remarkable palliative results following the radiation in cases of inoperable cancer of the cervix have modified our viewpoint as to the cases which fall within the elective surgical class, for our former rule was, when in doubt as to the extent of the growth, operate; but we now reverse the policy, and in these cases we employ radium. Under this restrictive policy our percentage of operative cases has shrunk, but we trust that under this conservative elective policy, better curative results from a radical hysterectomy will be secured in the future. We justify this conservative attitude by the assertion that in 100 inoperable cases treated, local healing has occurred in 52 per cent. This does not mean, however, that all of these 52 patients are alive, for several are dead of metastasis but without return of the local cervical process primarily destroyed by the radium. Even though the patient died from the secondary invasion, this is a remarkable showing as to palliative results, exceeding in our experience all previous remedies, and we trust that several in our service will survive the five-year test.

One of the terrifying symptoms for the patient and her family is the more or less massive vaginal hemorrhage. Of our 100 cases, 60 were completely relieved of this symptom. There was a recurrence of hemorrhage in 10, and in only 4 was it uninfluenced. Vaginal discharge other than hemorrhage was checked in 51, uninfluenced in 15. Of those suffering pain, 23 were relieved and 14 were not relieved. In some cases the relief of pain was only temporary, varying from a few days to a month or more.

A few surgeons have advocated the use of radium preliminary to hysterectomy. From this view we are radical dissenters, for it hardly appears conceivable that a remedy which works effectively for at least 2 centimeters from its point of application can be improved upon by a surgeon's knife, limited by such insuperable barriers as the bladder in front, the rectum posteriorly, and the ureters and pelvic vessels laterally. We, therefore, adhere strictly to one rule, namely, never to attempt an operation on any case that has been healed locally by radium. It appears to us a most unwise surgical policy to subject a patient to the hazards of a radical operation, rendered more dangerous by the dense cicatricial tissue which forms in the wake of a successful radium application, in what we believe to be a fatuous attempt to secure still more lasting results. Indeed, we are inclined to the view that under such manipulation nests of degenerating cancer cells enclosed in a sarcophagus of dense connective tissue may actually be liberated and thus render abortive an otherwise good palliative result.

Radium, as is shown in our series of cases, is by no means an infallible panacea for cancer. There is no way of determining which case will be benefited by its use. There is, beyond doubt, a certain percentage, as estimated by our observation, in which cancerous growths are not retarded by radiotherapy; indeed, in an occasional case it would appear that there is a positive acceleration of the new growth. That many

cases show an astounding improvement with local disappearance of the ulceration cannot be gainsaid. In our series, several instances occurred in which the results achieved were so remarkable as to be almost incredible. Doubtless in some of these cases the fire is but smouldering, and will break out sooner or later with renewed violence, as several of our cases have proved, but upon the whole, this treatment yields today the most highly encouraging palliative results and we trust that permanent results will follow in a definite percentage of otherwise hopeless cases.

In the discussion of cancer cases the question of hospital economics must not be lost sight of. The length of stay in the hospital following a radical operation will average at least three weeks; whereas after the application of radium not more than three days will be required. When complications arise after radical operations they are usually serious, entailing much suffering. Such patients, on returning home, are likely to remain semi-invalids for several weeks or months, and when, as is frequently the case, there is a rapid continuation of the disease, they become a heavy burden to a poor family. In the comparison of statistics, this difference between the two classes of patients is greatly in favor of those treated by radium, a fact that tends to incline us strongly to the use of radium in border-line cases, which we formerly subjected to a radical operation.

Removal of the uterus in cases of cancer of the fundus has yielded such good results that we do not feel justified in taking any chances with radium, even in the border-line suspects, except in those where there is a serious surgical contra-indication. In our series of 100 cases, only 4 of carcinoma of the fundus were thus treated. Our surgical attitudes toward the cervical and fundal growths are diametrically opposite. In border-line cases of cancer of the cervix we invariably employ radium. In advanced cases of cancer of the fundus, we invariably perform a hysterectomy.

A pessimistic view dominates our outlook in the surgical treatment of the cervical growths, if the pathological process is at all advanced, whereas fundal growths may be viewed with a cheerful optimism even when the cancerous process is extensive. As a palliative agent we may assert with full assurance that we have never obtained results with any other methods that have even approached in beneficence those secured by radiotherapy. The treatment is simple and entails no distress to the patient, and the results in checking hemorrhage are immediate and in a very large number of cases this symptom never returns even in the fatal cases. Because of the well-nigh miraculous action of radium in the occasional case, there is danger of unbridled optimism and no one should let the occasional astounding result cloud his vision when it comes to a judicious consideration as to the best procedure in a large series of cases.

RADIUM IN INOPERABLE CANCER OF CERVIX, VAGINA AND URETHRA.

SUMMARY	
Diagnosis:	
Carcinoma of cervix	74
Carcinoma of fundus	4
Carcinoma of vagina	7
Recurrent	10
Urethra	3
Chorio-epithelioma	2
	<hr/> 100
Age of patients:	
20 to 30 years	4
30 to 35 "	2
35 to 40 "	6
40 to 45 "	11
45 to 50 "	17
50 to 55 "	22
55 to 60 "	13
60 to 70 "	19
70 to 80 "	6
	<hr/> 100
History of patient after application of radium—	
Hemorrhage: Complete relief	60
Recurrence	10
Uninfluenced	4
Not stated	15
Leucorrhea: Checked	51
Uninfluenced	15
Not stated	23
Pain: Relieved	23
Not relieved	14
Not stated	52
Fistulae: Rectovaginal	4
Vesicovaginal	4
Local healing	52
No effect on growth	8
Hastened growth	2
Immediate untoward result	0
Stay in hospital—average three days.	
Patient not traced	2
Too recent to report	9

RESULTS			
DIED		ALIVE	
2 to 4 months	7	2 to 4 months	7
4 to 6 "	6	4 to 6 "	8
6 to 8 "	7	6 to 8 "	6
8 to 10 "	5	8 to 10 "	6
10 to 12 "	0	10 to 12 "	9
12 to 14 "	3	12 to 14 "	6
14 to 18 "	3	14 to 18 "	6
18 to 22 "	0	18 to 22 "	2
22 to 26 "	1	22 to 26 "	1
26 to 28 "	0	26 to 28 "	1
28 to 30 "	0	28 to 30 "	3
	<hr/> 32		<hr/> 55

Died few days after leaving hospital from heart failure	1
Died (time not stated).	1
Not traced	2
Too recent to report	9

Stone⁷ has recently made a report on the estimated value of radium therapy in uterine cancer, based on a study of 400 cases treated at the Memorial Hospital in New York, 80 additional cases being under observation at the time of the report. Radium, they have found, is an agent more peculiarly suitable for the arrest of the progress of the disease than any other method that has been hitherto employed, being more effective in primary lesions than in recurrences. New patients are kept in the hospital three, four, or more days in order that the medical records, physical examinations and laboratory tests may be made, and sufficient time allowed to recover from the nausea and slight malaise which the applications of radium may cause. For purposes of classification, the cases are divided into (1) extremely advanced, (2) advanced, (3) border-line, and (4) early.

Extremely advanced lesions include those in which all the pelvic structures appear to be palpably involved, forming either bulky tumors in the upper part of the pelvis and often extending far down into the septa between the vagina and rectum or bladder, or a large, dugout, ulcerating crater surrounded by a mere shell of tumor tissue closely adjacent to the rectal and bladder walls. Stone feels that any interference with the nutrition of a tumor is an important factor in the result of radium therapy of tumors. A bulky and necrotic tumor never shows any improvement, and in lesions with an ulcerating crater, radium may cause the premature production of rectal and vesical fistulæ. In a few extremely advanced cases, however, if the nutrition of the tissues appears good, the application of a large amount of heavily screened radium, applied in a pack at some distance from the normal tissue overlying the tumor, will often afford considerable relief from pain.

It is in advanced cases, where the parametrial tissues are definitely infiltrated, but where there is a palpable limitation of the tumor process, that radium is effective in arresting the process—relieving pain, stopping hemorrhage and discharge, and restoring the general health—the adenocarcinomatous type being more susceptible to the action of radium than the infiltrating epithelioma. The changes produced by an effective dose of radium take place slowly, the tissues becoming edematous and softer by the end of the first week, the discharges sometimes being temporarily increased. By the third week the extra-uterine lesion is less well defined, the pain and discharge gradually diminish, until within two months little, if any, tumor tissue may be felt, leaving finally, in many cases, only an atrophic uterus fixed in tissue which is indistinguishable from fibrous connective tissue. In some cases a certain amount of tumor tissue may remain, though there is improvement in general health. How long is treatment to be continued in such cases? Under further application of radium the lesion may improve, but a small ulcerating surface of the cervical mucosa may persist, due to poor nutrition in the surrounding zone of tissue, the age of the patient, or overdosage at the first treatment.

Radium will convert the border-line lesions, or those in which the

⁷ American Journal of Obstetrics, 1918, lxxvii, 390.

growth is largely limited to the uterine wall, into operable lesions, and without surgery it will effect a disappearance of the gross evidences of the disease, and restore health in a large number of such lesions more effectively than surgery alone has hitherto been able to do.

Early lesions, either of the cervix or body, are rare. However, on the basis of experimental and clinical evidence, the application of radium prior to hysterectomy in these early lesions would seem a justifiable mode of procedure in Stone's opinion.

Prophylactic radium therapy after operation is important. It is possible that a number of low-power emanation tubes wrapped in the gauze drainage of the vaginal wound at the time of operation may prove an efficient means. The experiences with radium in the treatment of uterine cancer at the Memorial Hospital in New York have been presented by Bailey,⁸ and he states that the recurrent cases showed the lowest percentage of improvement. The recurrence is usually behind the vaginal vault, and the vagina itself is usually foreshortened and contracted. The primary cases are more amenable to the application of radium and the results are slightly better than when previous treatment had been instituted. Twenty-one per cent. of this class showed marked improvement with the possibility of remaining free from cancer. When a period of two years passes, a fairly good estimate may be made as to ultimate results, and although not over 15 per cent. of the cases lived to that period, in those that did live the probabilities of complete retrogression are great. On the other hand, over 80 per cent. lived through the first six months, and it is very difficult to sift the good from the bad, for nearly all showed local improvement. Bailey is convinced that the inoperable cases do better without the preliminary Percy treatment, and he also believes that the initial dose of radium should be high, and that it should seldom be repeated for the same area. Cross-firing should be made use of from within and from the surface of the body.

Janeway,⁹ in a very interesting article on the action of radium on cancer, lays particular stress on the possibilities of radium in cancer of mucous membranes, a field in which other forms of treatment have been so universally futile. It should be borne in mind, however, that the favorable character of the results is in inverse proportion to the age of the growth. Hence, the great importance of radiotherapy in the early stages while the growth is still circumscribed. The value of applying radium prior to operation to improve the local conditions has been emphasized by Purefoy,¹⁰ who is in favor of operation in all cases of malignant disease of the uterus unless a fatal outcome appears sure. Corscaden¹¹ prefers radium treatment to the Percy cauterization method, and considers the results of the latter poor when compared with those of radium, there being greater discomfort and a longer period of treat-

⁸ Surgery, Gynecology and Obstetrics, 1918, xxvi, 625.

⁹ *Ibid.*, 196.

¹⁰ Dublin Journal of Medical Science, 1918, cxlv, 201.

¹¹ New York Academy of Medicine, Section on Obstetrics and Gynecology, December 27, 1917.

ment required. Reynolds,¹² and many others, strongly recommend radiotherapy as a palliative measure in cases of inoperable uterine cancer, since radiation has been found to lessen or abolish pain and to decrease hemorrhage and offensive discharge.

Burnam,¹³ in his excellent paper on the technical problems connected with the use of radium by the gynecologist, calls particular attention to the dangers of overradiation, which may increase pains and, if extreme, may cause serious injuries or even death. Hence, the tremendous need of carefully regulating the amounts to be applied and of properly protecting the parts liable to injury. The principle upon which radiotherapy is based is that normal tissues can withstand an intensity of radium which is destructive to most pathological tissues, the difference in tolerance making it possible to destroy the pathological tissues without injuring the normal tissue when the proper dose is used. If this condition does not hold true, as it may not in the case of metastatic growths, and if the normal tissue is an absolutely essential part, then radiotherapy is prohibited. It must also be remembered that too little radiation, since it may stimulate growth, may be quite as harmful as overstimulation. However, no hard-and-fast rules can be laid down, because, as Burnam points out so well, the radiosensitivity of both normal and abnormal tissues varies in different individuals and in different tissues in the same individual. Hence, it is difficult to estimate the effect to be produced by a given amount of radiation. It is possible, however, in a broad way to compare the toleration of normal tissues in different parts of the body to radium, by using the normal skin as a standard, and determining the erythema dose. Using the normal skin erythema dose as a unit, Burnam has found that a dose varying from one to one-half was sufficient to destroy a skin epithelioma, while one one-thousandth of this unit dose was sufficient to destroy the tissue of lymphosarcoma or of the splenomyelogenous leukemic spleen. Some normal tissues are very tolerant, particularly the fibrous tissue of the cervix uteri, of the bladder, vagina and even of the rectum. Clinically it has been found that the ovary is at least ten times as easily injured as normal skin; that the vaginal wall is four or five times as tolerant, that the mucous membrane and the bladder wall are twice as tolerant; that the lining of the uterus is about equally as tolerant as the skin; that the rectal mucous membrane is equally tolerant; and that the cervix uteri is at least twenty times as tolerant. As to the epithelial new growths in gynecology, Burnam has found that the adenocarcinomata of the cervix and of the body of the uterus are generally more easily injured by radiation than the epitheliomata of these organs and have somewhat less tolerance than the basal-celled epitheliomata of the skin. The adeno type of rectal carcinomata is four or five times less tolerant than the skin epitheliomata. The ordinary papilloma and the malignant papilloma of the bladder correspond in tolerance to the skin epitheliomata of the basal-celled type. Uterine fibroid tissue is four or five times more susceptible to the influence of radium than normal skin. When small surfaces and distances

¹² Boston Medical and Surgical Journal, 1918, ii, 89.

¹³ Transactions of the American Gynecological Society, 1918, xliii, 336.

less than 1 cm. are tested, the destruction dose is three or four times the size of the erythema dose, but when the distance and the area of skin are greater, the two doses are more nearly equal. Therefore, before treatment is begun a preliminary study must be made of the distances of the growth from the portals through which the treatment is to be given. Whenever possible, cross-fire radiation is advocated, the surrounding normal tissues to be pushed aside and to be protected by

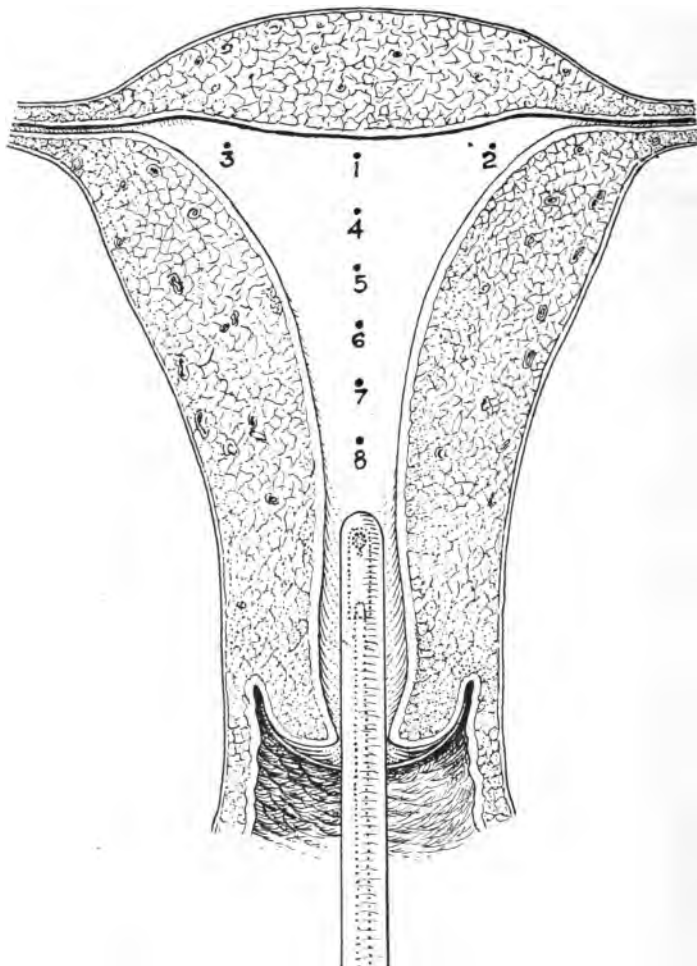


FIG. 58

metal screens, sufficient screening being employed to give a pure gamma radiation. A single tube is used in both the cervix and body of the uterus; in the former it remains in one position, while in the latter it is moved about to prevent irritation of the surface (Fig. 58). An applicator of any desired length for flat surfaces may be made by combining tubes, as, for example, along the vaginal or rectal wall. Small growths of the bladder may be reached by direct application through a

cystoscope, while radiations from the exterior are most satisfactory for infiltrating vesical tumors. For uterine fibroids, uterine bleeding and tumors of the ovary, a distance of about 15 cm. from the skin is recommended, a lead box being placed on a measured gauze pack above the surface. Burnam now is of the opinion that properly repeated fractional doses are usually more effectual than the single massive dose. It must be remembered, in employing fractional doses, that the full effect of an intensive exposure cannot be determined for at least six weeks. Therefore, at least this period should be allowed to intervene between treatments, and treatment should always be discontinued with the minimal effective dose.

Roentgenotherapy. An interesting piece of research has been carried out by Murphy and Taylor¹⁴ on the effect of the *x*-rays on immunity. A series of mice which had been artificially immunized against a transplantable carcinoma, proved to be immune when inoculated a second time with the tumor in question. There was a marked increase in the number of the circulating lymphocytes in these immune animals; hence the possibility that the lymphocyte is a potent factor in the immunity to cancer. When these immune animals were exposed to the *x*-rays they were again rendered susceptible to the same tumor.

There is considerable divergence of opinion as to the therapeutic value of the roentgen rays in cancer. Mayo¹⁵ suggests that the effect of the *x*-rays may be to lower the permanence of the control bodies in the cell; thus prolonged *x*-ray treatment without protective shields for certain types of rays adds a factor of danger in the production of cancer. In Phillips¹⁶ opinion, the value of the *x*-rays in carcinoma is uncertain, but he advocates its trial, since the treatment is painless and has no bad after-effects, and in case of failure one may resort to operation. If the treatment is successful, menopause is produced and is unattended by nervous disturbances. Armstrong,¹⁷ and a number of others, have gone on record as favoring *x*-ray treatment in cases of inoperable carcinoma, but are much against its ever taking the place of surgery. Pfahler¹⁸ believes that carcinoma of the uterus should be operated upon if discovered in the operable stage and there are no contra-indications, but in every instance operation should be followed by deep roentgenotherapy. In operable growths the best results are obtained by the use of radium internally and roentgenotherapy externally. In the earlier cases one may expect amelioration, possibly a cure.

Other Non-operative Measures. The ACETONE TREATMENT of uterine cancer, described by Gellhorn in 1907, has been strongly endorsed recently by Woebus,¹⁹ who believes it to be an exceedingly valuable measure in inoperable cases. According to Woebus's technic, a preliminary curettage is performed, using Boldt's cancer spoon. The patient is then placed in the Trendelenburg position, a tubular glass speculum introduced and the entire cavity filled with acetone. Since

¹⁴ Journal of Experimental Medicine, 1918, xxviii, 1.

¹⁵ Canada Medical Association Journal, September, 1918, p. 786.

¹⁶ Archives of Radiotherapy and Electrotherapy, 1918, xxii, 333.

¹⁷ Lancet, April, 1918, p. 190.

¹⁸ Journal of Michigan State Medical Society, 1918, xvii, 320.

¹⁹ Journal of Missouri State Medical Association, 1918, xv, 116.

the blood tends to dilute the acetone, a repetition of the injection is advisable. The fluid is then removed by means of cotton swabs and the cavity packed with gauze which is allowed to remain until the next morning. A cotton tampon saturated with vaseline is introduced and the speculum removed. Care should be taken not to allow the acetone to come in contact with the vulva, perineum and anus, since it is very irritating to these structures, while not at all so to the vaginal mucosa. Treatments should be repeated every third to fifth day for as long as necessary.

Some end-results of the treatment of uterine cancer by *heat* have been reported by Percy.²⁰ Out of 65 cases in which he applied this form of treatment, 10 are living and clinically free from cancer from two to nine years following the treatment ($15\frac{3}{13}$ per cent). On the basis of his results, Percy feels that the subject must gain new interest among surgeons.

Surgical Treatment of Cancer of the Uterus. The early recognition of cancer of the uterus, whether of the cervix or body, is of the utmost importance, since a permanent cure is possible only if the cancer is still a local disease and before malignant invasion has occurred.

The method of procedure to be chosen in operation upon these tumors depends partly upon the stage of the growth and partly upon the condition of the patient. Boldt²¹ is in favor of the vaginal method of hysterectomy if the patient is obese and the disease still in its incipency, using the Schauta technic. In all corporeal cancers this author employs the vaginal method with the exception of advanced cases, in which there would be danger of mutilation and soiling of the field with cancer tissue. If extirpation is done by means of the cautery, the cautery knife, according to Boldt, should be cold when brought in contact with the tissues, and then heated to prevent bleeding by a too rapid division of the vessels. If the radical abdominal operation is advisable, the author advises removal of uterus, adnexa, extensive removal of the parametria, the accessible pelvic and iliac glands and the upper part of the vagina, particularly if the cancer is located in the vaginal part of the cervix. He emphasizes the necessity of keeping all patients under observation for a number of years, in order to operate upon recurrences at the earliest possible moment. After a careful review of the literature and an analysis of his own cases, Weiss²² has come to the conclusion that the Werder method for operations on cancers of the cervix has the following advantages: Low primary operative mortality, absence of shock, diminished infection, complete hemostasis, less pain, smooth convalescence and higher percentage of permanent cures.

Egli²³ has recently published a report of the status of 80 patients in whom a hysterectomy had been performed for uterine cancer during the ten years prior to 1911. The operability of a group of 325 cases of cancer of the uterus was 50.7 per cent. Of the group of 80 patients operated on, there was no recurrence for over five years in 33.75 per cent. Of the

²⁰ American Journal of Obstetrics, 1918, lxxvii, 93.

²¹ Medical Record, 1918, xciii, 62.

²² American Journal of Obstetrics, 1918, lxxviii, 776.

²³ Correspondenz-Blatt f. Schweiz. Aerzte, 1918, xlviii, 699.

27 patients surviving over five years, the vaginal method had been used exclusively in the 14 cases of cancer of the cervix and in 12 out of the 13 cases of cancer of the body of the uterus. The vaginal and abdominal methods were employed in about an equal number of cases, but only one of the abdominally operated cases was found to be living five years after operation.

In an article on the Control and Management of Cancer, Reynolds²⁴ calls attention to the fact that in many situations ligation of a number of the nutrient arteries often leads to decrease in size of the growth and to consequent decrease, or even considerably prolonged disappearance of pain.

TWO-STAGE OPERATION FOR CARCINOMA OF THE PREGNANT UTERUS UNDER PARAVERTEBRAL ANESTHESIA. While all operators are in accord that carcinoma of the pregnant uterus is an extremely grave complication, Mason and Konrad²⁵ are of the opinion that by a two-stage operation under paravertebral anesthesia, shock may be gradually reduced and frequently the life of both mother and baby saved. In a careful review of the literature they failed to find a single case in which a radical cure had been undertaken in a two-stage procedure; in most instances the child was delivered and the uterus extirpated at the same time, or, the tumor being inoperable, the child was delivered by the abdominal route. According to the authors, the extreme vascularity of the entire pelvis at the time of delivery makes a careful pelvic dissection difficult, if not impossible, the condition of the patient at that time necessitates haste which is often incompatible with thoroughness, and hence the chances of recurrence are increased. They, therefore, advocate that a Cesarean section be performed at the first sitting and that the hysterectomy be undertaken at a second laparotomy after the patient has recovered from the shock and loss of blood incident to delivery, the intervening period being short and never extending over the complete uterine involution. As a further means of diminishing shock, both procedures may be carried out under paravertebral anesthesia. They observed no untoward general reactions, and anesthesia lasted from two to four hours. In the author's case twenty-two days were allowed to elapse between Cesarean section and hysterectomy. The patient's life was undoubtedly prolonged by the two-stage procedure, but the extent of the growth even at the time of the first operation made ultimate recovery impossible, death occurring four and a half months after delivery.

Cancer of the Cervix Complicating Triplet Pregnancy. A cancer of the cervix complicated by pregnancy is a very unusual condition; particularly is this so in a case reported by Watson,²⁶ in which cancer of the cervix complicated a triple pregnancy. At operation, which was performed after the patient had been four months pregnant, the uterus was found to be enlarged, soft and fluctuating. The size of the uterus made an opening in the midline necessary before removal could be undertaken. On rupturing the membranes, first one fetus, then another, and finally a third were delivered. All the placental tissues and membranes were

²⁴ Boston Medical and Surgical Journal, 1918, clxxix, 147.

²⁵ Surgery, Gynecology and Obstetrics, 1918, xxvii, 75.

²⁶ Transactions of the American Gynecological Society, 1918, xliii, 445.

removed and the opening in the uterus closed with interrupted sutures. The peri-uterine tissue was divided well outside the ureters and a large cuff of vagina was freed and cut across after double clamping below the cervix. The patient made a satisfactory recovery and was discharged six weeks after operation.

Sarcoma of the Uterus Arising from the Endometrium. An interesting case of sarcoma arising from the endometrium has been reported by Brady.²⁷ It is unusual in that the tumor appears to rise from the connective tissue itself, not from a malignant change in a fibroma, as is generally the case. No myomatous changes could be discovered at any point. The patient, aged fifty-three, had been married thirty-one years and had had three children, who were living and well. There had been a cessation of menses several years before, but there had been a bloody discharge for about six months. The uterus was enlarged to twice its normal size, regular in outline and freely movable. Curettings demonstrated carcinomatous tissue (round cell) and a panhysterectomy was performed. The patient made a satisfactory recovery, though convalescence was complicated by an attack of malaria. When the uterine cavity was opened there was seen a heart-shaped growth attached to the upper part of the fundus near the left cornu. The growth measured 4 x 5 x 4 cm. and felt quite soft. In fresh section the cut surface was homogeneous, the color white, mottled with light yellow. Several large venous sinuses stood out plainly. The uterine mucosa seemed normal everywhere except at the point where the tumor had arisen. The tubes, ovaries and cervix were perfectly normal, and careful measurements showed them not to be enlarged. There were no adhesions around the uterus, tubes or ovaries. Sections demonstrated that the growth was sarcoma, with many pigmented places.

NON-MALIGNANT CONDITIONS OF THE UTERUS.

Radiotherapy in Fibroids. For the past five years Kelly²⁸ has been treating fibroid tumors with radium, having had altogether 211 cases under treatment, and he has found that all uncomplicated fibroids of whatever size are favorably influenced by this treatment, which stops hemorrhage, together with menses, the latter either temporarily or permanently, and either causes the tumor to disappear completely or to shrink to very small dimensions. Before beginning radiation, he makes sure that the case is one of uncomplicated fibroid tumor, excluding malignancy by curettage and histological examination, and appendicitis, cholelithiasis and inflammatory conditions of the tubes and ovaries by careful examination. Of the 211 cases treated with radium up to the present time, 87 are cured, the tumors having either entirely disappeared or so reduced as to be insignificant; 14 are so well that, in spite of repeated requests, they have failed to report for examination; in 62 instances the tumors have diminished in size. The last group is not static; it is composed largely of recently treated cases (less than two years) in which the radium has not had time to produce its full effect.

²⁷ Bulletin of Johns Hopkins Hospital, 1918, xxix, 164.

²⁸ Journal of the Medical Society of New Jersey, 1918, xv, 145.

The members of this group are constantly augmenting the first group. In addition to these, 2 complicated cases are reported unimproved; 8 were operated on after radiation; 2 died of causes unconnected with the treatment; 12 have sent no report; 14 are too early for results, and 10 did not complete treatment.

Of the 2 cases reported unimproved, one was complicated by gall-stones, and operation advised but refused; in the other, a huge tumor choked the pelvis so completely that abdominal radiation had to be employed. Of the 8 cases operated on after radiation, in 3 cases the fibroid condition was complicated by ovarian cysts, in 2 bleeding was not controlled by a single radiation and, the patients desiring it, an operation was done; in 3 cases there was insufficient reduction of the tumor mass, a calcified uterus being found in 1 case.

The technic as outlined by Kelly consists in the application of 300 to 500 millicuries of the emanation, covered with a rubber cot, on the end of a uterine sound within the uterus for about three hours. This may be repeated in a few months, or an abdominal treatment may be given. For the latter form of treatment, one or more grams of filtered radium are used. The package should be placed on the abdomen and shifted about for several hours, giving the skin a minimum and the tumor a maximum radiation. Immediately after treatment there may be nausea for twenty-four hours, some abdominal tenderness, and possibly a leucorrhœal discharge for several weeks. A second or third treatment is frequently required to bring about amenorrhea. In younger patients, a mild treatment is given so that bleeding may be controlled, but menstruation continued.

On the basis of his five years' experience, Kelly feels that radium is the treatment of choice in uncomplicated fibroid tumors of the uterus.

The great value of radium in fibroid tumors of the uterus is further borne out by the experience of Watkins.²⁹ His patient, a woman, aged forty years, suffered from multiple fibroid tumors which made the uterus the size of a three months' pregnancy. Fifty milligrams of radium with 1 mm. brass screening covered by rubber, were inserted into the uterine cavity. Three months later the uterus was normal in size, no tumor could be palpated and the patient had skipped the last two periods. In case of chronic metritis, Watkins' results were equally encouraging, the hyperplastic uterus becoming normal in size, two periods following radium insertion, then a cessation for eight months followed by regular menstruation. In a case of submucous uterine fibroid with cancer, the results were not so good, rectal and vesical symptoms following the application of radium, probably because of insufficient screening. In a case of extensive inoperable cancer of the body of the uterus, there could be no hope of cure, but three administrations of radium were of great palliative benefit, being followed by a marked diminution in pain, a cessation of all offensive discharge and absence of bleeding up to the time of death. He, therefore, believes that the value of radium as a palliative measure in these very grave cases cannot be overemphasized.

²⁹ Surg. Clinics of Chicago, 1918, No. 1, ii, 89.

Miller³⁰ has recently reported his results in a series of 26 cases of myomata treated with radium; in 22 cases the bleeding ceased within five weeks and did not return. In 5 cases it was controlled for a few months, but was never so severe after its reappearance, while in two of these the menses became regular after eight months. In only 2 cases had the radium failed, and these would very probably have been relieved by another radiation. Control of bleeding is not the only desideratum in treating fibroid tumors; the growth of the tumor must be stopped and, if possible, the tumor be made to disappear. In 16 cases examined from three months to two and a half years after treatment, there has been a reduction in the size of the tumor varying from complete disappearance in 3 cases to about one-half the original size in practically 50 per cent. of the number. Some further points in regard to the fibroid group are worthy of comment, namely, most of the growths selected for radium treatment were small, the only large tumors being those presenting contra-indications to operation. This feature is emphasized because Miller does not wish to imply that radium is to supplant surgery in the treatment of fibroids, but it is a most valuable adjunct to surgery. Two cases in this series illustrate conclusively that radium is more effective than the roentgen rays. Both had been given twenty exposures by an experienced roentgenologist, who employed the Gauss technic, with only temporary results. Only one intra-uterine application of radium sufficed to stop the bleeding permanently.

Roentgenotherapy in Fibroids. Enthusiastic reports have appeared from time to time concerning the use of the roentgen rays in the treatment of fibroid tumors of the uterus. Brettauer³¹ has treated 32 cases of uterine fibroids with massive x-ray exposures, with the result that permanent amenorrhea occurred in 25 cases, or 78 per cent., and temporary amenorrhea in 7, or 22 per cent. Four of the latter cases were between thirty and forty years of age, and the character of uterine bleeding was that of a scanty, regular menstruation; in the other 3 cases there was an irregular flow, small in amount and occurring at intervals of from three to six months. The tumors had varied in size, some reaching up to the umbilicus. In almost every case a decided reduction in the size of the uterus was apparent; in some, no trace of the former large fibroids could be detected.

Brettauer's technic is as follows: The abdominal, gluteal and dorsal regions are divided into a number of small fields; twelve to the abdominal and six to the gluteal and dorsal regions. Each of these fields receives an amount of radiation equal to 20 to 25 x. A Coolidge tube is used with a penetration backing up of a 9-inch spark; the focal distance is 18 cm. The amount of current is 4 ma, with each field exposed for five minutes. The filters used are 4 mm. aluminum, several layers of thick photographic paper and a flat loofah sponge. The tube stand is tilted at a different angle with each field, so as to permit the rays to pass through the uterus and ovaries at different angles and allow the most efficient cross-fire administration.

The treatments were given at intervals varying from one to three

³⁰ Surgery, Gynecology and Obstetrics, 1918, xxvi, 495.

³¹ American Journal of Obstetrics, 1918, lxxviii, 415.

weeks, depending upon the patient's tolerance to the *x*-rays, the urgency of the symptoms to be relieved, and upon extraneous conditions (such as patients living out of town).

With the fractional doses the abdomen is divided into four fields, the dorsal and gluteal regions into two. The treatments are given twice a week, two fields covered alternately at each treatment. In this way each field receives a treatment every ten days, with a longer interval of rest during the menstrual period. The technic and the amount of rays given to each field are the same as with the massive dosage.

With the exception of nausea and headache, lasting for possibly twenty-four hours, there were no untoward symptoms. The occurrence of burns, so often mentioned and so greatly exaggerated, has been conspicuous only by its absence.

As a result of this series of cases, Brettauer has reached the following conclusions:

At an age below forty-five, the *x*-ray treatment for fibroids should not be the choice, but should be employed only when operative measures are not advisable or are refused. Between the ages of forty-five and fifty-five, *x*-ray treatment should be the method of choice, and no patient should be deprived of the right to undergo it. With an open cervix and a distinct diagnosis of the submucous development of a fibroid, operative measures promise better results. Patients with relaxation and laceration of the genital tract should be excepted. These cause no symptoms while the uterus is large and above the pelvis, but when, as a result of the treatment, the uterus becomes smaller and sinks down into the pelvis, serious inconvenience is caused and operative interference becomes necessary for its relief. Uterine hemorrhages due to fibroids in women beyond the age of fifty-five should raise a suspicion of sarcomatous degeneration, and operative measures are preferable to any other form of treatment.

Oliva³² has come to somewhat similar conclusions as the result of his experiences with *x*-rays and radium in the treatment of a series of 35 cases of uterine fibromyoma. In 25 cases there was a total disappearance of the tumor, but only in 10 cases has more than two years passed since the last radiation. Six cases showed a reduction to about one-third the original size of the tumor, and amenorrhea persisted. In the remaining 4 cases amenorrhea was produced, but no reduction in the size of the tumor. In 5 cases roentgen rays with deep massive doses were employed alone; in 28, roentgen rays and radium were combined in the treatment, and in 2 cases radium alone was used. Oliva considers roentgen rays the treatment of choice in small interstitial and intra-ligamentous fibromyomata in women approaching, or past, the menopause. However, when such a tumor occurs in younger women, resort should be had to surgery at once, since removal with preservation of function is possible in the majority of cases. According to Oliva, subserous fibromyomata, especially if large, demand surgical intervention at once, regardless of the age of the patient, because of their volume and the pressure they exert. In cases in which operation is contra-

³² Gazz. d. osp. ed. clin., 1918, xxxix, 345.

indicated or must be postponed because of the condition of the patient, the roentgen rays are very helpful and exert a certain hemostatic and atrophic action.

Some gynecologists consider that *x*-ray treatment should be limited to those fibroids which have resulted in pain and severe hemorrhage—the interstitial myomata—surgical measures being definitely indicated in the subserous variety. Phillips³³ takes exception to this view and believes that every case of fibroid tumor causing symptoms from rapid growth or hemorrhage should submit to a course of *x*-rays before resorting to hysterectomy. Out of 19 interstitial growths, 16 have responded to the *x*-ray treatment and have been almost entirely relieved of their symptoms. Submucous pedunculated fibroids, and those with various degenerations, such as myxomatous, cystic or calcareous, are not suitable, Phillips believes, for this form of treatment.

Surgical Treatment of Uterine Fibroids. Broun³⁴ has made a study of 1500 selective cases of myomata uteri operated on at the Woman's Hospital, 1910 to 1917. As a result of the operations, 28 patients died; of these, 7 died from embolus, chiefly between the eighth and twentieth day, 7 died from peritonitis and the remainder from various causes. The mortality rate for the series of 1500 cases was therefore 1.86 per cent. The coincident pathological conditions found were as follows:

Malignant conditions present in	4 per cent.
Ovarian disease in	3 "
Tubal (excluding salpingitis) in	7 "
Uterine myomatous changes and tuberculous conditions in	7 "
Pregnancy (normal and extra-uterine) in	4 "
Chronic and subacute appendicitis in	11 "

TABLE OF COINCIDENT PATHOLOGICAL CONDITIONS ASSOCIATED WITH
1500 CONSECUTIVE MYOMATA UTERI.

Malignant	57
Carcinoma corpus uteri	20
Carcinoma coli uteri	9
Sarcoma	7
Carcinoma of ovary	4
Papillomatous ovarian cysts	17
Ovarian	58
Adenocystoma of ovary	36
Intraligamentous cyst	3
Dermoid cysts of ovary	14
Fibroid of ovary	1
Abscess of ovary	4
Tubal	265
Tubercular salpingitis	6
Pyosalpinx	58
Hydrosalpinx	48
Salpingitis	153
Uterine	107
Necrotic myomata	83
Calcareous myomata	22
Tubercular endometritis	2
Pregnancy	60
Normal	51
Extra-uterine	9
Appendicitis, chronic and subacute	167
Mortality	28
Per cent.	1.86

³³ Archives of Radiotherapy and Electrotherapy, 1918, xxii, 333.

³⁴ American Journal of Obstetrics, 1918, p. 410.

Broun considers that the use of radium and x -rays should be limited to cases in which it is inadvisable to do any form of operation and to hemorrhage of myopathic origin or from small and absolutely uncomplicated myomata of the uterus. Surgery is indicated, he feels, in all cases of myomata that cannot be completely mapped out by manual examination and known to be free from coincident complications unless other physical contra-indications are present.

Bonney³⁵ is of the opinion that the field of myomectomy should be considerably extended. He now performs this more conservative operation with complete success in many cases in which he previously did a hysterectomy. Hysterectomy, he agrees, is indicated in a considerable group of cases—in elderly women with large and multiple tumors; cases in which anemia is so extreme that further loss of blood, even the amount of a normal menstrual period, is undesirable; inflamed or degenerate tumors, or large tumors growing in the supravaginal cervix. But there are a considerable number of cases, principally young patients, who are suffering from menorrhagia, dysmenorrhea, or abdominopelvic pain because of uterine fibroids. It is in these cases that Bonney advocates myomectomy to supplant hysterectomy. Continuance of menorrhagia after myomectomy is attributable to one of the following causes: (a) A small submucous fibroid missed at operation; (b) to endometrial thickening; (c) to the fact that the uterus has remained much hypertrophied although all the tumors have been removed; or (d) to a degenerate condition of the uterine wall. Bonney believes the possibility of recurrence is very slight; he remembers only 1 case in which he removed a uterus subsequently for this reason. He feels, moreover, that the fear that the uterus after myomectomy will not stand the strain of pregnancy is groundless, since no tissue in the body heals more perfectly than the uterine muscle. While it cannot be denied that hemorrhage during and after myomectomy is greater than in hysterectomy, Bonney is of the opinion that if the proper precautions are taken, the average risk of myomectomy is probably about the same as that of hysterectomy under corresponding conditions. In certain cases, because of the size or multiplicity of the growths, the dangers of myomectomy may be greater. Moreover, the psychic value of the conserved uterus must not be forgotten. While the conceptional value of a uterus in which a fibroid has developed, even though the tumor has been removed, is probably less than that of a normal uterus, nevertheless removal of the womb has a certain psychic effect upon the patient and is accompanied by a certain rebellion and regret. On the other hand, Rochard³⁶ feels that total abdominal hysterectomy possesses many advantages over subtotal hysterectomy. A cervix left *in situ* may become the seat of an epithelioma. Since 1908, he has been performing the total hysterectomy, but dividing it into two stages. In the first stage a subtotal hysterectomy is done, and this is followed by the secondary removal of the cervix. He believes that the difficulties of the total operation are divided in this manner. Between February, 1917, and February, 1918, the author

³⁵ British Medical Journal, 1918, i, 278

³⁶ Bull. Acad. de Méd., 1918, lxxxix, 356.

did 68 hysterectomies for salpingitis, uterine fibroids, ovarian cancer, etc., of which 48 were subtotal and 20 total. There was but one death in this series plus 7 other recent total hysterectomies. Total hysterectomy is divided into two stages whenever it appears doubtful, on palpation, whether the process be uterine or in the adnexa, also when the lower pelvis is involved in double pelvic suppuration.

A somewhat new method of abdominal hysterectomy has been described by Bégouin³⁷ for fibroma with the lower pole impacted; it is termed the *excavation method*. The superior pole of the fibroma is seized with the left hand and pulled up with forceps. After clamping the uterine and utero-ovarian vessels on each side, a circular incision is made at the periphery of the tumor; starting from this circumference, successive wide and deep cones are described with the bistoury, the center being below the fibromatous mass. The upper abdominal part of the fibroma is then detached and removed. The whole central part is now accessible and a pull with the forceps on the edges of the cupola effects its separation from the surrounding tissues. Bégouin has performed the operation seven times, and he considers it superior to all other methods in the fibroma with impacted lower pole.

The *relation of uterine fibroids to pregnancy, labor and the puerperium* is a point of considerable importance to the gynecologist. MacFarlane³⁸ believes that while uterine fibroids do not necessarily cause difficult labor, nevertheless constant vigilance is demanded, for they may require operative interference in place of the usual expectant treatment. During pregnancy, the softening of the uterine muscle may cause torsion of the pedicle of a subserous fibroid. On the other hand, the presence of a fibroid during pregnancy may result in accidental hemorrhage and a premature end of the pregnancy. Since operative intervention may result in premature labor during pregnancy, the expectant treatment is the procedure of choice. The only conditions which demand operation under these circumstances are pressure symptoms, torsion of the pedicle or of uterus, degeneration of the tumor, or location of the tumor in such a place that the child cannot be born by the natural passages. Pressure symptoms usually call for abdominal section and removal of the tumor by ligation of the pedicle or enucleation. In cases of degeneration it is wise, if the pregnancy has proceeded to the point that the child is viable, to perform Cesarean section and remove the uterus by subtotal hysterectomy. If torsion of the pedicle has occurred, the pedicle should be ligatured and the growth removed. In case the uterus is twisted upon its cervix, Cesarean section followed by hysterectomy may be necessary. In those cases in which the fibroid is in such a position as to obstruct delivery by the natural routes, MacFarlane advocates the performance of a Cesarean section a day or two before full time, at which time a myomectomy or hysterectomy may be performed according to the demands of the case, the former, of course, being the procedure of choice whenever possible. It is possible that future pregnancies may even take place in a uterus treated

³⁷ Bull. et mém. Soc. de Chir. de Paris, 1918, xliv, 295.

³⁸ Glasgow Medical Journal, 1918, lxxxix, 257.

in this manner. If removal of the tumor is not required during pregnancy, there may be some difficulties at the time of labor. A subserous myomata below the presenting part, or a subserous tumor in the cervix may cause complete obstruction, or malpresentation. Intra-uterine or intra-abdominal hemorrhage may occur. On the other hand, pressure of the child's parts on the tumor may cause bruising and result in sepsis. During the puerperium MacFarlane feels that great care is needed in differentiating between a submucous fibroid and a complete inversion of the uterus. A fibroid during this period may be responsible for sepsis or displacement of the uterus.

Myofibrosis or Metritis. Phillips³⁹ believes that metritis or myofibroma is particularly amenable to x-ray treatment. The treatment, however, should not be applied until the uterine cavity has been explored to eliminate the possibility of malignant disease. Phillips has seen five cases in which one set of sittings produced an entire cessation of menstruation and a gradual atrophy of the uterus.

Russ and Wilson⁴⁰ have called attention to the group of cases known as fibrosis uteri in which it was formerly believed the increase in fibrous tissue in the myometrium was the chief cause of hemorrhage, but this origin does not seem reasonable to them, since spontaneous cures occasionally occur. The authors feel that the endocrine glands are closely related to this condition, possibly in the form of a perverted follicular activity of the ovary or a diminished secretion of the thyroid. Until the exact cause of the condition is known, we cannot hope to treat it in a fully successful manner. If there are signs of hypothyroidism, they advocate the administration of thyroid extract and in some cases roentgenization of the ovaries may control bleeding due to perverted ovarian function.

Uterine Bleeding. The value of *radiotherapy* in cases of *profuse or irregular uterine hemorrhages* induced by small myomata, and in the so-called myopathic hemorrhages of benign origin, arising from muscular or vascular changes in uteri of women approaching the climacterium is now pretty definitely established, but as to various points regarding the treatment we are still in the experimental stage. We⁴¹ use radium only in very light dosage in the treatment of young women in whom a tumor is not palpable, but who are suffering from a depleting flow at the periods. The flow diminishes as a rule to within normal limits but, occasionally, a permanent amenorrhea results. The latter crisis can and will surely be precipitated by too large a dosage. Further, we do not employ radium and thus far see no valid reason for discarding an operation when the tumor is massive and by its presence is handicapping the function of adjacent organs by pressure. Large tumors are much more likely to be accompanied by inflammatory lesions, and there is always an element of doubt in the diagnosis. In such cases, we believe we serve the best professional ends in advising an abdominal operation which permits a complete survey of the entire pathological field, and

³⁹ Loc. cit.

⁴⁰ Texas State Journal of Medicine, 1918, xiii, 346.

⁴¹ Loc. cit.

the removal of such tissues as are necessary to restore our patients to health.

In young women in whom a myomectomy is possible, we advise operation, for in these cases the uterus may be restored to normal and the ovaries are preserved. Briefly summarized, we may say that we apply radium in the following groups of cases:

1. In large dosage, 50 mg. for twenty-four hours, in women suffering with myopathic hemorrhage or menorrhagia from myoma, in women over forty years of age. In such cases we expect to bring on the menopause, and in practically all we are successful.

2. In smaller dosage, 25 to 50 mg. for from three to eight hours, in young women with excessive menses incident to myopathic changes, in very small myomata, in polypoid endometritis, and in those cases of irregular and profuse bleeding attributed to excessive functional activity of ovaries.

We do not employ radium:

1. When the tumors are larger than a three to five months' pregnant uterus, or

2. In a young woman with a single myoma which may be removed by myomectomy.

We have now completed a series of 100 cases, all of which are available for statistical study. They are divided as follows:

Myoma	60
Chronic metritis	36
Polypoid endometritis	3
Cervical stump	1
	<hr/>
	100

This series of 100 cases comprises patients who have been treated for uterine hemorrhage of myomatous or myopathic origin. In no case was the tumor of large size, and in each the only symptom was excessive bleeding.

SUMMARY OF RESULTS FROM THE USE OF RADIUM IN MYOPATHIC HEMORRHAGE.

Pathological conditions:	
Myoma	60
Chronic metritis	36
Polypoid endometritis	3
Cervical stump	1
	<hr/>
	100
Age of patients:	
17 to 20 years	2
20 to 25 "	3
25 to 30 "	5
30 to 35 "	13
35 to 40 "	16
40 to 45 "	28
45 to 50 "	23
50 to 55 "	10
	<hr/>
	100

Influence on periods:

Immediate cessation	40
One period	18
Two or more periods	23
Return to normal and regular	15
No relief	2
No stated	2

100

Return of bleeding:

None	74
To normal after months of cessation	4
One or twice only, then amenorrhea	1
Profuse	1

HISTORY OF PATIENT AFTER THE APPLICATION OF RADIUM.

Leucorrhea:

None	44
Profuse with complete cessation	19
Slight	26
Cured by radium	5
Not stated	6

100

Pain:

Absent	64
Present	30
Not stated	6

100

Nausea and vomiting:

None	58
Present	25
Not stated	17

100

Complications:

Present (pyometra)	1
None	97
Subsequent operation necessary	2

100

Menopausal symptoms (according to age):

17 to 20 years	1
20 to 25 "	1
25 to 30 "	1
30 to 35 "	8
35 to 40 "	8
40 to 45 "	19
45 to 50 "	10
50 to 55 "	5

53

None	37
Not stated	10

100

The term uterine hemorrhage, as employed by Miller,⁴² is limited to bleeding due to metropathies, disturbed ovarian function, chronic endometritis, metritis and fibroids of the uterus. Bleeding associated with syphilis, chronic liver and heart disease, lung and kidney affections,

⁴² Surgery, Gynecology and Obstetrics, 1918, xxvi, 495.

as well as the ordinary complications of pregnancy, is naturally eliminated and mentioned to emphasize the point that uterine bleeding is only a symptom and demands careful differentiation and accurate diagnosis in its management. Every gynecologist is impressed with the large number of cases of persistent bleeding that eventually require hysterectomy. If he is conscientious he can only regret keenly the necessity of performing a serious mutilating operation, especially when the pathologist reports little, if any, pathological change in the uterus. Radium has proved to be the long-sought specific in these cases, because of the simplicity of application, the short amount of time required to effect a cure, and the uniformly satisfactory results obtained. The most plausible explanation of the action of radium in these cases is that it produces extensive structural changes in the endometrium.

The author has had considerable experience along these lines and, for the purpose of study, has divided his cases into groups. The first group includes the cases commonly denoted as myopathia hemorrhagica (hemorrhage of the menopause). These cases, as a rule, present little, if any, defined anatomical cause to account for the bleeding, and comprise some of the most serious instances of acute hemorrhage. It occurs most commonly in women approaching the menopause, though it may be found in comparatively young women. The uterus may be normal in size or slightly enlarged, and often presents a normal endometrium. The bleeding is supposed to be due to a disproportion of connective tissue over muscular tissue in the myometrium or to some aberration of ovarian secretion or other ductless glands. In these cases the bleeding was controlled primarily in 100 per cent., with 90 per cent. of permanent results. The average time from the treatment until amenorrhea occurred was four weeks. The second group included patients presenting a history of menorrhagia or metrorrhagia lasting for months or years, practically all of whom had a uniformly enlarged, hard or occasionally flabby, uterus. Many gave a history of puerperal complications. In some, the origin of the trouble appeared to be extensive lacerations of the cervix, involving the parametrium. These cases are ordinarily classified as chronic metritis, polypoid endometritis, hyperplasia, fibrosis, etc. Amenorrhea was produced in every case within one month after treatment, and all but 2 of the 18 cases have recently been communicated with and none report a return of the bleeding. Many presented an enlarged uterus before the treatment, but everyone examined three months or longer after the treatment showed a uterus approximately normal in size. The menopausal symptoms seemed to be more pronounced in this group than in any of the other series. In a third group the author records 2 cases of serious uterine bleeding in young girls who had been treated by rest, tonics, astringents, ovarian extract and curettage. The uterine scrapings apparently showed hyperplastic glandular endometritis. The application of small doses of radium produced results that were all that could be desired, even though the risk of permanent amenorrhea was greater than should be taken in the ordinary case of this type. Both of these cases now menstruate regularly after a period of amenorrhea which lasted three months.

While the results obtained by various authorities with the use of radium are practically the same, the dosage employed has been by no means standardized. It has been practically established that a 1000-milligram-hour exposure is almost certain to produce permanent cessation of the menses, but in the treatment of fibroids the size of the growth and the degree of hemorrhage should govern the amount used and the duration of the exposures. If bleeding is the only annoyance a woman experiences who suffers from a fibroid, is there sufficient justification for performing hysterectomy? To this question the author answers in the negative. If the growth is sufficiently large to produce pressure symptoms, operation is preferable because of the time consumed in reducing it by radium. If evidence of infection or degeneration exists, or the appendages are diseased, operation is the best procedure. If the woman is young she should be advised to submit to operation with the idea of performing myomectomy and preserving the uterus. For small and medium-sized growths and those presenting contra-indications to operation, radium is the ideal remedial agent. Submucous growths should be treated surgically unless contra-indications to operation are present, owing to the tendency of this type to become infected or develop other degenerative changes.

Infection of the Uterus. Some of the most interesting and, at the same time, most useful studies that have been elaborated by an American gynecologist in recent years have been those of Curtis,⁴³ whose past work along the line of leucorrhea and other endometrial disturbances are probably familiar to all. It is fitting, therefore, to call attention to the latest presentation of this worker, which consists of a combined bacteriological and histological study of the endometrium in health and in disease. The work is based on observations made upon a series of 118 cases. It was Curtis's object to make a study of the endometrium, exclusive of the cervix, in all conditions usually encountered, except those associated with pregnancy. All of the material used was secured from uteri removed at operation. Scrapings from the endometrium are so liable to contamination that cultures from them are not included in this series. The technic that was employed in securing the material for this study consisted in cauterizing the stump of the cervix and the entire length of the peritoneal surface of the uterus and then bisecting the anterior wall. With sterile instruments the greater part of the endometrium is excised in its entire thickness down to the muscle layer, and is placed in sterile containers to be ground and cultured. The remainder serves for immediate examination and for microscopic study.

The reason for undertaking such a study as this is because Curtis believes that it is especially desirable to compare histological evidences of chronic inflammation of the endometrium with cultures from the same material. Though we are interested in the frequency with which the endometrium yields histological signs of endometritis, after all a problem of more vital clinical importance is whether bacteria live in those tissues which are altered. We wish to learn whether the presence of mono-

⁴³ *Surgery, Gynecology and Obstetrics*, 1918, xxvi, 178.

nuclear cells in a given piece of tissue means a possible focal infection of the uterus, and we need to know whether such a uterine cavity can be handled with impunity at operation or must be considered a zone of danger from which infection may spread.

In the classification of cases studied, it has seemed best to distinguish between nulliparous and parous patients. Among the latter, pregnancy has introduced the possibility of fundus contamination and has also rendered the cervical canal relatively more patent for the ascent of germs into the uterus. Each of these two groups has again been divided into those in which the history has been normal and those with history or operative evidence of pelvic infection.

GROUP 1. The endometrium of nullipara without history of infection. Of 26 supposedly non-infected nulliparous cases, cultures and tissues were normal in 23. Streptococci were isolated from 1 case, while in 2 other cases, which had been curetted respectively eight and six days before hysterectomy, mixed growth appeared in the cultures and the histological evidences of endometritis were present.

GROUP 2. The endometrium of nullipara with history of gross evidence of pelvic infection. Of the 13 patients in this class, 12 yielded no growth. Histologically, 9 of these were normal, 1 showed tuberculosis, 1 a slight cellular infiltration and 1 was invaded by polynuclear and plasma cells. The endometrium of a case with recurrent infection of sixteen years' duration yielded gonococci in cultures and histological evidence of chronic endometritis.

GROUP 3. The endometrium of parous women without history or gross evidence of pelvic infection. Of the 47 women in this class, in only 2 cases did the endometrium show growth. One of these patients, with intra-uterine manipulation preliminary to operation, yielded a moderate number of colonies in mixed culture and was microscopically normal. The other, a victim of persistent uterine hemorrhage, showed anerobic streptococcus infection and microscopic evidence of endometritis.

GROUP 4. The endometrium of parous patients with history or gross evidence of pelvic infection. Of the 32 patients belonging in this class, 9 showed a growth in the culture of the endometrium; 4 of these, regularly exposed to re-infection, yielded gonococci and showed histological subacute endometritis. Another, without exposure for six months had inflammation of the endometrium and Fallopian tube, with gonococci from both. Two cases of many years' standing yielded respectively a diplococcus and a streptococcus. Ten endometria without growth proved microscopically normal, 2 contained round cells, 1 a post-menstrual polynuclear increase, 7 had plasma and round cells and 3 revealed distinct histological endometritis.

As a result of these extensive investigations, Curtis has come to the conclusion that, pyometra and recent exploration of the uterus excepted, the endometrium almost never shows bacteria except when there is infection of adjacent pelvic tissues. Chronic endometritis *per se*, with bacteria present in smears or cultures, is practically to be ruled out as a clinical entity. Several points of clinical importance come up in this work. In the first place we may consider infection of the endometrium

consequent to curettage. In certain cases normal scrapings have been obtained from the uterus; then, several days thereafter, in the endometrium secured by hysterectomy mixed cultures and endometritis have been found. Infection is perhaps not a customary result of curettage, but it appears not uncommon. This calls attention to the fact that preparation for instrumentation of the uterine cavity does not ordinarily include cleansing of the cervical canal, yet this tissue is freely accessible to all vaginal flora. Curtis believes, therefore, that it is a wise precaution to gently introduce an iodid applicator as far into the cervix as it is patulous before attempting to pass instruments. In regard to the problem of intra-uterine therapy, it has been found that chronic infection of the corpus uteri speaks for almost certain involvement of other pelvic organs. Intra-uterine applications are therefore of little avail, for the most important focus of infection is well beyond their reach. Again, in the absence of bacteria, it may be desired to rid the patient of a persistent discharge. Study of the question makes it appear that mucus secreted from the body of the uterus is in very small amount and limited mostly to the premenstrual period. In the cervix are glands, prolific in activity, especially adapted to mucous secretion. It is here, in the cervix, up to the level of the internal os, that we will do best to look for infection, and it is against discharge from the cervix that treatment can be efficiently directed.

Escape of Foreign Material from the Uterine Veins. By injecting bismuth into the uterine cavity through the cervix and making radiographic studies of the uterus, tubes and ovaries, Sampson⁴⁴ through his highly scientific and clever experiments has been able to ascertain the shape of this cavity and also to determine by what routes and under what circumstances material escapes from this cavity. Material removed at operation or autopsy was used in the studies. In cases in which the Fallopian tubes were patent, bismuth passed into them, the ease of passage depending on the degree of patency of the tubes. Thus the possibility that irrigating fluid introduced into the uterine cavity may eventually reach the peritoneal cavity through the tubes, bringing about a salpingitis and peritonitis. When the endometrium was intact, Sampson found that bismuth would not pass into the venous uterine sinuses, even when great force was employed. When, however, the endometrium had been removed by curettage or when the patient had been menstruating at the time of hysterectomy, then the bismuth passed into the venous sinuses, the ease of passage varying with the size of the sinuses and the degree of relaxation of the uterine wall. By studying the uterus in which the veins had been injected, large "receiving sinuses" were demonstrated radiating from the base of the endometrium into the myometrium. When these sinuses were exposed by removing the overlying endometrium and the uterus was relaxed, thus holding the lumina of the sinuses open, fluid and small solid material easily escape from the the uterine cavity into them, when pressure in the uterine cavity is greater than that in the sinuses, and then into the venous circulation

⁴⁴ Transactions of the American Gynecological Society, 1918, xliii, 16.

outside the uterus. This increased pressure may be brought about by uterine contraction following relaxation. In this way it is easy to understand the occurrence of puerperal infection and the presence of placental cells in veins outside the uterus.

Primary Hydatid Cysts of the Uterus. A primary hydatid cyst of the uterus itself is a comparatively rare condition. After a careful literary review, Turenne⁴⁵ was able to find out 10 actual cases. To this number he adds another case upon which he has recently operated. The uterus, which was removed, was about 11 or 12 cm. in diameter and had a cavity with smooth shining walls about 8 or 9 cm. in diameter. The anterior wall was 2 to 3 mm. thick, while the posterior wall, separating the cyst from the uterine cavity, was 3 cm. thick. The uterine mucosa was thickened and the walls of the organ hypertrophied. There was no evidence of peri- or parametritis. The extracted membrane showed all the micro- and macroscopic characteristics of hydatid cyst. Regarding treatment, the author states that vaginal or abdominal hysterectomy, according to the conditions of the patient (age, general state, dimensions of the tumor, vaginal amplitude, infection, etc.), is the intervention of choice, a cystectomy with partial uterine resection being indicated only in cases of very small cysts. The prognosis, according to the reported cases, is not bad, provided the patients are operated upon before the cyst becomes infected.

TECHNIC.

Bloodless Repair of the Cervix. After experimentation with various kinds of clamps and tourniquets, Heineberg⁴⁶ has devised the following technic for bloodless repair of the cervix uteri:

1. Introduce a self-retaining speculum in the vagina.
2. Grasp the anterior lip of the cervix in the median line with an ordinary double tenaculum.
3. Dilate the cervix moderately, chiefly to determine the precise location and direction of the canal.
4. Draw the cervix toward one side and apply the angulated forceps to the cervix well above the level of the proposed amputation or denudation.
5. Draw the cervix to the other side and apply the second angulated forceps opposite the first one.
6. Remove the ordinary tenaculum.
7. Place the handles of the forceps together. Stretch the rubber ring over them and push it up on the cervix to above the retaining balls.
8. Separate the handles of the forceps and hand them to the assistant.

Hemostasis is thus maintained by the use of a rubber ring and two tenaculum forceps which, in addition to being angulated, possess a pedunculated ball on the outer aspect of each blade just above the angle, the balls holding the rubber ring in such a position that it compresses the cervix above the grasp of the forceps.

⁴⁵ Surgery, Gynecology and Obstetrics, 1918, xxvi, 446.

⁴⁶ American Journal of Obstetrics, 1918, lxxvii, 652.

A New Operation for Obstructive Dysmenorrhea and Sterility. While the original Pozzi operation meets all the requirements in cases of true "pin-hole" os where the obstruction is at the external os, there are many cases in which angulation of the uterocervical canal near the internal os is responsible for the dysmenorrhea and sterility. It is in the latter cases that Frank's⁴⁷ operation, by which the cervical canal is straightened and the stenosis at the internal os corrected, is particularly applicable. The cervix is grasped at the uterovaginal junction with small uterine tenaculum forceps, one on each side, and pulled outward and upward. An incision is made in the middle of the posterior lip extending well up to and past the flexion. At this point the tenacula are removed and used to spread apart the two halves of the posterior lip. With a very small-bladed, spear-shaped knife, made on the Catlin order, wedges of tissue are removed from the two raw surfaces of the posterior lip, leaving a trough. Just enough tissue is then removed to allow easy and exact approximation of the entire cervical and vaginal surfaces. The first suture is commenced at the angle of the posterior incision and extreme care taken to approximate accurately the internal cervical and the vaginal mucosa at the point. This is important, to avoid healing by granulation and so secondary contraction. Twenty- or forty-day, No. 1 chromic gut is used in a continuous or interrupted suture. Frank suggests that the principle of this operation might be applied in cases of retroflexion of the uterus producing symptom³.

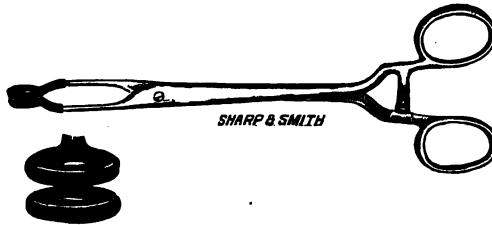


FIG. 59.—Viscera forceps. (Schoenberg.)

Modified Uterine and Viscera Forceps for Careful Manipulation of Tissue. Schoenberg⁴⁸ has modified slightly the rubber-covered visceral forceps designed by him in 1910. The holding surface has been increased by making the metal of the jaws heavier and flatter. The space between the blades from the jaw to the lock is now about 1 cm. (Fig. 59), preventing the pinching of tissue beyond the rubber-covered jaw. These forceps are very useful in handling intestines, ligaments, or peritoneal folds. The author feels they are safe and efficient and in addition are very simple.

The new uterine forceps (Fig. 60) are more easily applied to the uterus, since they conform more nearly to the size and shape of the uterus, the posterior blade being slightly longer than the anterior blade. The shank of the handle has been bent forward and the width of the jaw narrowed.

⁴⁷ Journal of the American Medical Association, 1918, lxx, 985.

⁴⁸ Surgery, Gynecology and Obstetrics, 1918, xxvi, 237.

These forceps are particularly adapted for holding the retrodisplaced uterus and facilitating operative procedures on the round ligaments or other pelvic structures.

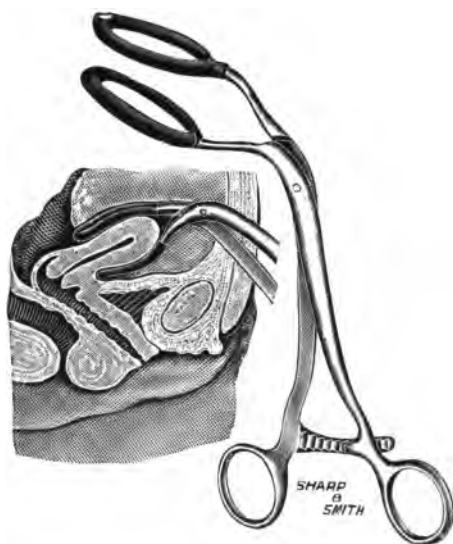


FIG. 60.—Elevating forceps. (Schoenberg.)

Technic of Operations for Cystocele and Uterine Prolapse. Each year sees a few improvements and modifications in the various operations devised for the treatment of cystocele and uterine prolapse, conditions which have occupied the attentions of gynecologists since ancient time, even as early as 1550 B.C., as Rawls⁴⁹ brings out in his recent historical review of the literature on this subject. As the result of much research and careful studies of the pelvic structures, several technics have been devised for the repair of these conditions, particularly by Martin, Frank and Stone, based on a dissection of the anterior wall with suturing of the lateral bundles of fascia.

Rawls,⁵⁰ working independently, has elaborated a somewhat similar technic which, he feels, promises to restore the anatomical relations in the bladder and to prevent the many abnormal conditions which frequently result as the after-effects of cystocele operations, by offering a strong and anatomical restoration of the supports of the bladder without causing antero-posterior shortening of the anterior wall of the vagina. The overlapping of the fascia and the transverse mattress sutures seem to be original with Rawls. His method may be used in all forms of cystocele, but in cases with complete prolapse of the uterus, other additional methods are required to relieve injury to the posterior segment of the "holding apparatus" and the injury to the "supporting apparatus."

⁴⁹ American Journal of Obstetrics, 1918, lxxvii, 328.

⁵⁰ Ibid., 1918, lxxvi, 359.

The technic of Rawls's operation is as follows: A small volsellum forceps is applied to the mucous membrane of the anterior vaginal wall about 1 cm. above the cervix and another forceps about 1 cm. below the external urethral orifice. Between these forceps a vertical incision is made through the mucosa and superficially into the underlying tissues. These cut edges are retracted and the incision carried forward until the mid-portion of the bladder is reached. It is then continued downward until the cervical attachment of the bladder pillars and the so-called uterovesical ligament are demonstrated. The latter is cut with scissors, keeping well in the midline in order to avoid severing any of the cervical attachments of the bladder pillars. The bladder is next separated by blunt dissection as far up as its peritoneal reflexion from the cervix and well out to either side, care being taken to free it from the underlying pillars upward to the urethra. If there is an urethrocele the dissection is carried up to the external urethral orifice. When the bladder is well mobilized, its pillars are dissected from the underlying vaginal mucosa. The next step must be done carefully in order to avoid destroying or buttonholing the fascial sling. With a finger under the mucosa as a guide, the thinned-out fascial edge is dissected with a knife from the underlying mucosa. The mucosa flap is made paper-thin and forceps are applied as tractors to the fascial and mucosal edges. This cutting dissection is continued from the midline, downward and upward for a short distance laterally until a distinct line of cleavage can be demonstrated the whole length of the primary incision, after which further separation by blunt dissections is secured from the overlying pillars well out on either side to the "arcus tendineus." The bladder and its true lateral ligaments are now freely mobilized and the latter are overlapped from side to side by transverse mattress sutures of kangaroo tendon, one or two sutures entering the cervical tissue at the level of the internal os. These sutures prevent antero-posterior shortening of the anterior vaginal wall and draw the underlying fascia smoothly under the overlapping fascia. The cervical suture re-attaches the fascia to its original place on the cervix and forms a shelf on which the bladder rests. The free edge of the overlapping fascia is then closed over the underlapped fascia by interrupted kangaroo-tendon sutures. The thin vaginal mucosa flap is now excised for a short distance on either side and its edges approximated in the midline by interrupted chromic catgut.

Rawls's first operation according to this technic was performed June 5, 1917. It is, therefore, too early to report the final results. However, of 17 cases operated upon by this method, he states that he has always succeeded in dissecting out a satisfactory fascia-like tissue and the primary cure of the cystocele has been most satisfactory.

According to Watkins,⁵¹ the essential features of operations for the repair of cystocele and uterine prolapse are wide incision anterior to the cervix, free separation of the herniated part of the bladder, closure of the hernial opening by circular sutures, restoration and fixation of

⁵¹ Surgery, Gynecology and Obstetrics, 1918, xxvi, 570.

the urethrocele and perineorrhaphy, while amputation of the cervix, trachelorrhaphy, plastic surgery on the broad ligaments and vaginal fixation are adjuncts which may be frequently utilized. The following are the procedures, as outlined by Watkins, to be used singly or collectively, according to the needs of the case:

Transverse Incision. The transverse incision in front of the cervix should extend freely across the anterior vaginal wall to permit the cervix to tilt easily upward and backward as the operation progresses. This lengthens the anterior vaginal wall and allows the body of the uterus to drop forward without undue flexure. The anterior vaginal wall is often congenitally or otherwise shortened in these cases.

Separation of the Anterior Vaginal Wall from the Bladder. Blunt dissection with Mayo scissors saves time and lessens bleeding and traumatism if care is taken to find the plane of fascia between the vagina and bladder. The width of separation varies. It should not be wide enough to endanger the ureters or injure large veins, yet should include all redundant mucous membrane and should permit complete separation of the herniated part of the bladder.

Separation of the Bladder from the Cervix. This is also most satisfactorily done with scissors, if caution is taken to find the dividing plane of fascia. The herniated portion of the bladder should now be completely freed from the sac. The peritoneum is incised if the cystocele is large, if intraperitoneal exploration is desired, if the uterus is retrodisplaced, or if vaginal fixation of the round ligaments is contemplated. At this time amputation of the cervix, if indicated, is done. Watkins believes in amputation in occasional cases of excessive elongation of the cervix only, because it endangers labor and stenosis.

Plastic Operations upon the Broad Ligaments. Plastic operations on the broad ligaments are a valuable adjunct to the operation if the uterus is much prolapsed, much increased in size, or if the anterior vaginal wall is much shortened.

Vaginal Fixation of the Round Ligaments. The technic is much the same as that formerly employed in the treatment of retropositions of the uterus. It is especially valuable when the prolapse is complicated by backward displacement of the uterus. It is also of great value in cases of extensive prolapse of the uterus. It adds materially to our ability to cure some of the very bad cases without subjecting them to operations to produce sterility. The round ligaments are not long enough for vaginal fixation without undue tension, except when the uterus is retrodisplaced or much prolapsed. The ligaments should be firmly fixed to the submucous connective tissue by interrupted, buried, fine linen or silk suture at a place in the vaginal wall that will restore and fix the urethrocele, which is almost invariably present, to its normal location. The point of fixation will be further considered later.

Advancement of the Anterior Vaginal Wall upon the Uterus. This consists in changing the place of attachment of the vaginal wall to the uterus to a plane higher on the uterus than formerly occupied, as devised by Goffe. The more the vaginal wall is advanced upon the uterus, the more certain must be the cure of the bladder and uterine

displacements, but, because of the possible complication of pregnancy and labor, it is not safe to attach the vagina much higher than the anterior reflexion of the peritoneum.

Excision of the Vaginal Flaps. Redundant tissue should be excised to an extent consistent with minimum tension upon sutures. The hypertrophied mucosa (skin-like tissue), which is generally present over the base of the urethra, should be excised, otherwise it is liable to protrude later.

Sutures. Interrupted, buried, fine linen or silk sutures are advocated for the broad ligament; for suture of loops of the round ligaments and in exceptional cases two or three such sutures may be needed in the connective tissue. Otherwise, interrupted or continuous Claudius catgut should be used entirely. The part of the wound caused by excision of the hypertrophied mucosa over the base of the urethra should be closed first. The placing of the first "circular" suture is highly important, as it determines the place the urethra will be left in, it closes all or most of the hernial opening of the cystocele, and it should insure an anterior position of the uterus. It should include the vaginal wall, so that, when tied, it will restore the urethra to its normal location which is one of relative fixation. The suture should pass through the anterior surface of the uterus at a place about its point of pivotal action when tipped forward or backward, so that when tied it keeps the body anteriorly. When tied, care should be taken not to include a knuckle of the bladder. Succeeding sutures should parallel this one at short distances until the wound is closed.

A new operative *technic* has been devised by Collins⁵² for cases of *complete prolapse of the uterus* in which the uterine ligaments have so lost their elasticity that the organ remains outside the body even when the patient is lying down. Since the majority of patients requiring this operation are elderly women with long-standing bladder derangement, Collins recommends that they be under observation for some time prior to operation during which time the power of the kidneys to withstand the sudden relief of backward pressure through complete emptying of the bladder should be carefully tested. This is done by suspending the uterus high in the pelvis with a gauze tampon and introducing a Pezzer catheter in the bladder for several days preceding operation. This may be done several times if satisfactory results are not obtained the first time.

The *technic* of the operation is briefly as follows: A transverse Pfannenstiel incision is made over the pelvis, through the aponeurosis of the recti muscles, after which a parallel incision is made two and one-half inches long and one-fourth inch above the first, thus forming a strip of aponeurosis with natural attachments at either end. The recti muscles are then separated, the peritoneum incised longitudinally, and a supravaginal hysterectomy performed, removing a V-shaped piece out of the cervix and thus leaving an anterior and posterior flap on the cervix. The broad ligaments may usually be ligated *en masse* in these

⁵² Surgery, Gynecology and Obstetrics, 1918, xxvii, 326.

cases The two cervical flaps are then held forward and the stumps of the broad ligaments sutured to each other and to the posterior surface of the cervix. At this juncture the cervical flaps are held apart, the strip of aponeurosis dropped in the cervical trough which has been formed and the flaps sutured over the strip. The peritoneum and recti muscles should be sutured around the cervix, while the edges of the aponeurosis are sutured over the cervical stump and the supporting strip of aponeurosis. This method, the author feels, is preferable to Kocher's, inasmuch as no large pieces of uterine tissue are left in the abdominal walls between the aponeurotic and muscular layer and because suspension is accomplished by a normally attached strip of aponeurosis and the union of similar dense structure over this strip.

CYSTOSCOPIC STUDY OF THE END-RESULTS OF VARIOUS FORMS OF CYSTOCELE OPERATIONS. The condition of the interior of the bladder after cystocele operations has seldom been given special consideration, attention having been centered principally on restoring the anterior vaginal wall to an apparently normal state by an operation which would insure a permanent result. The interior of the bladder must necessarily be very tolerant, since symptoms seldom develop until infection has occurred, even though, as has been found by Broun and Rawls⁵³ in their recent cystoscopic studies, the base of the bladder is thrown into folds and sulci in most instances after cystocele operations. The question naturally arises as to whether such a condition does not render more possible some after disturbance of a systemic character. In their cystoscopic studies, Broun and Rawls have noted that that kind of operation seemed to have no effect upon the degree of distortion of the base of the bladder. In anchoring the bladder base to a higher plane with sutures, attaching it to the broad ligament, proportionately as many abnormalities were produced as by the other method of leaving the bladder free after its separation from the uterus and bringing together the tissues underneath it. The ideal operation should not only provide a permanent vaginal restoration of the prolapsed anterior wall, but should also leave the base of the bladder in the normal plane. The authors believe it is the degree of anterior prolapse which decides whether the base of the bladder is left in a normal or convoluted state. Patients with only a moderate prolapse, upon whom a small area of separation of the mucosa was done, seemed less susceptible to extensive folding of the base than those with an extensive prolapse and proportionately larger separation. Rawls is of the opinion that if due care is exercised in preserving the fascial pillars of the bladder when separating the vaginal mucosa, and equal attention is devoted to freeing the bladder from these pillars and from its uterine attachment, equally good results will be obtained in all degrees of cystocele, not only as to the vaginal aspect, but also in a minimum of folding of the base of the bladder, if not its complete absence.

⁵³ Surgery, Gynecology and Obstetrics, 1918, xxvi, 502.

OVARIES.

Tubal and Ovarian Hemorrhage. Even after excluding hemorrhages arising from tubal pregnancy and from overwhelming trauma or hemophilia, ovarian and tubal hemorrhages are not nearly so rare as one might suppose. Among the exciting causes, Bovée⁵⁴ includes trauma, ingestion of oxytoxics and emmenagogues designed to interrupt a supposed pregnancy, and among the predisposing causes are toxic conditions, inflammatory changes and pathological conditions, including neoplasms, instability of ovarian tissue and maladjustment of the internal secretions at puberty. These hemorrhages deserve particular study because of their close relation to pelvic hematocele. Excepting tubal pregnancy, non-gestational tubal and ovarian hemorrhages are the chief causes of pelvic hematocele. Ovarian hemorrhage may be stromal, follicular or of the corpus luteal variety. Stromal hemorrhage is frequently, though not always, a result of sclerocystic degeneration, chronic ovaritis, and is a serious condition. In this connection, Bovée calls attention to the fact that a large number of ovarian cysts do not necessarily indicate a sclerocystic condition, "cystic ovaries" being "indicative of ovarian hyperstimulation and overactivity rather than of hypofunction and disease, and, *caeteris paribus*, to be preserved rather than ablated. The sclerocystic ovary does not or should not enjoy such favorable consideration." Hemorrhage into these cysts may occur, sometimes resulting in multiple hematoma which may coalesce to form large hematomata, and the latter may rupture into the peritoneum if intracystic tension is removed. On the other hand, intracystic pressure may be sufficient to prevent invasion by blood escaping from the perifollicular zone of new bloodvessels and small infarcts may form outside the cyst lining, becoming stromal hematomata.

The symptoms arising from either the non-gestational tubal hemorrhage or ovarian hemorrhage are not definite and distinctive. According to Bovée they may vary from none in the cases in infancy to those at puberty resembling dysmenorrhea and even to severe attacks that have caused death or led to emergency abdominal section. There is usually tenderness and muscular rigidity of the whole abdomen. The history frequently begins with extreme exertion followed by pelvic pain, which may be paroxysmal or continuous, vomiting and collapse. Wilson calls abdominal pain and uterine hemorrhage the cardinal features, while others believe interference with the abdominal movements of respiration one of the chief signs.

In infancy and early menstrual period we are usually dealing with the follicular variety, while in later years, when infections are commoner, the stromal variety predominates. Cases have been seldom recognized until autopsy or until the symptoms were so grave that immediate operation was indicated, but Bovée feels that with study a correct diagnosis may be made and the condition differentiated from tubal pregnancy, ulcer of the intestine, appendicitis, and ingestion of poisons;

⁵⁴ Transactions of the American Gynecological Society, 1918, xliii, 76.

the gravity of the condition makes a correct and early diagnosis of the greatest importance. As to treatment, the more severe forms should be treated like cases of ectopic pregnancy, while rest and anodynes are indicated in the mild forms.

Hematogenous Infections of the Ovary. That the ovaries may be the seat of hematogenous infections has been recognized for several years, particularly since the work of Rosenow and Davis. However, the frequency and importance of such infections in contradistinction to direct extension of infection from the genital tract has not been sufficiently emphasized. A few cases of undoubted hematogenous infection of the ovary, particularly with the typhoid bacillus, have been reported, and recently Wiener⁵⁶ has reported a case of hematogenous infection of the ovary with the streptococcus hemolyticus. The patient, a young woman, aged eighteen years, had been suffering for two months with abdominal pains; examination revealed a large firm mass in the right lower quadrant dipping into the pelvis. At operation, a large ovarian mass was found on the right side firmly adherent to the broad ligament, the posterior surface of the uterus, and the rectum; there was also slight congestion of the distal half of the right tube in contact with the mass. The uterine half of the right tube, as well as the left tube, were normal. The mass proved to be an abscess the size of a grape-fruit which was clamped by its pedicle and removed, a gauze drain being inserted in the bed of the abscess and brought out through the lower angle of the wound. The abscess, probably an infected corpus luteum cyst, was filled with thick, greenish-yellow pus. Culture showed hemolytic streptococcus. The patient made a good recovery and examination three months later showed her to be in excellent health.

It is quite important that we should ascertain whether cases of infection in this manner are of frequent occurrence, since it is a question of sociological as well as medical import.

Acute Ileus Caused by the Appendix Being Adherent to the Right Ovary. While ileus has been found to be due to a variety of mechanical causes, the case recently reported by Straus⁵⁶ is rather unusual, showing that the ileus was due to adhesions between the appendix and an enlarged, cystic right ovary, the obstruction being a very short distance above the ileocecal valve. The adherent appendix was removed and the patient made an uneventful recovery so far as the ileus was concerned.

Tumors and Cysts of the Ovary. The question of the malignancy of cystic papillary growths of the ovary must apparently remain open, for the present at least. Often cases exhibiting some of the characteristics of malignancy will be quite unexpectedly and permanently cured by operation, while some which clinically appear to be benign will rapidly recur. Corcia⁵⁷ has recently reported the removal of a papillary cystadenoma of the ovary in a patient, aged thirty-two years, followed by no recurrence after seven years. At operation, the case appeared hopeless, the peritoneal cavity contained about five gallons of clear fluid and a

⁵⁶ Surgery, Gynecology and Obstetrics, 1918, xxvii, 622.

⁵⁶ Surgical Clinics of Chicago, No. 1, ii, 153.

⁵⁷ American Journal of Obstetrics, 1918, lxxvii, 62.

large number of various sized cysts surrounding a larger one, containing about a gallon of fluid. Numerous papillomata were scattered over the surfaces of the cysts as well as on the peritoneum, intestines, bladder and ovary of the opposite side. The central cyst was tapped and the whole mass, which had its origin on the left side, removed, as well as the right ovary and as much of the papillomata scattered over the other organs as possible. Examination from time to time during the next seven years showed no signs of recurrence.

While histological examination showed no sarcomatous or carcinomatous degeneration, clinically, Corcia classes the tumor as malignant because of the ascites, the implantation of papillomatous growths on other organs and the cachectic condition of the patient. In view of the very remarkable results in his case, Corcia has come to the following conclusions: (1) Papillary cystic growths must always be considered clinically malignant, because we do not know their outcome, but the operation may give unexpectedly good results. (2) Early operation is always desirable when a diagnosis of cyst is made. (3) In the advanced state, when there is ascites and great emaciation of the woman, the diagnosis of cyst is difficult, if not impossible, being confused with a general cancerous or tubercular affection of the abdomen.

After a careful analysis of 11 cases of papillomatous cysts of the ovary operated upon since 1910, Schwartz⁵⁸ has also come to the conclusion that the prognosis is not so bad as it is usually supposed to be. Out of his 11 cases, 1 is alive and well seven years after operation, and 3 four years after operation; of the remaining 7, 3 died in the hospital and 4 died within six months of their discharge from the hospital. Schwartz regards total extirpation of the uterus and adnexa as the ideal procedure, but even incomplete removal of the growth with proper drainage may be followed by complete recovery, and repeated operations for recurring growths are of a certain value. The examination of the ascitic fluid as bearing on prognosis and treatment may be of importance.

Sarcoma of the ovary at any age is not of common occurrence and particularly is this true of very young children; hence the case of sarcoma of the ovary in a child, twenty-three months of age, recently reported by Hayd,⁵⁹ is of interest both from the clinical and pathological standpoint. In his book on *Diseases of the Ovaries and Fallopian Tubes*, Bland Sutton reports only 60 cases of tumors of the ovary in girls under sixteen, and, of these, 28 were dermoids, 16 sarcomata and 16 cysts. At operation, Hayd removed the tumor, which was free in the abdomen, the right tube attached to it and also the appendix, which was long and curled upon itself. The uterus and left tube and ovary were normal, but the liver was enlarged and filled with nodular masses. The child died at the end of the fifth week, probably from a general sarcomatosis. Microscopic examination showed the tumor to be made up of rather large round cells with deeply staining vesicular nuclei and many cells showing karyokinetic figures. There was a great tendency to hemorrhagic infiltration, also to necrosis of the cells, some showing

⁵⁸ American Journal of Obstetrics, 1918, lxxviii, 79.

⁵⁹ Ibid., 764.

fatty degeneration. There were groups of these cells separated from each other by connective-tissue stroma, and there were numerous large spindle cells scattered in this stroma.

A rather curious case of ovarian cyst has recently been reported by Johnston,⁶⁰ the cyst complicating a tubal abortion occurring on that side. The patient, who had been pregnant eight weeks, suffered from acute abdominal pains; a mass could be felt behind and to the left of the uterus, filling a great part of the left pelvic cavity. Upon opening the abdomen, and removing a large blood clot from the pelvic cavity, an ovarian cyst the size of a large orange was revealed on the left side and the left tube curled round behind it with its fimbriated end beneath the cyst. The tube was somewhat enlarged, particularly at its fimbriated extremity, which was covered with congealed blood and slightly oozing. The tube and cyst were removed and the peritoneal cavity cleansed. The right ovary was also degenerated and of about the size of a large walnut, but since it appeared as healthy tissue, it was not excised. It seemed evident that the ovum came from the right ovary to the left tube, an ectopic gestation lodging in the fimbriæ and aborting into the abdominal cavity. Severe hemorrhage was prevented by the pressure of the cyst over the fimbriæ. The patient made an uneventful recovery except for a vaginal discharge which ceased in a week, and thirteen months later the patient gave birth to a healthy child.

Another rather unusual case of ovarian tumor has been reported by Armstrong,⁶¹ who, upon opening the abdomen, discovered bilateral twisted ovarian tumors, the one on the left being the size of a fetal head and that on the right somewhat larger. Considerable patience was required in removing the tumors since they had become gangrenous and adherent to adjacent structures. The appendix, which was much involved by adhesions to the tumor on the right side, was also removed. The patient made an uneventful recovery.

A case of hemorrhage into an ovarian cyst with symptoms simulating ectopic pregnancy has recently been reported by Waters.⁶² The patient, a secundipara, aged twenty-eight years, had been more than a week overdue with menstruation. Examination revealed a cervix of normal consistency and the fundus not enlarged; the left ovary was tender and slightly enlarged. A few days later the patient suffered severe abdominal pain and flowing was profuse, large clots of blood and fragments of "tissue" being passed. Bimanual examination now showed the external os to be slightly patulous, and on the left side of the pelvis, a tender globular and cystic mass the size of a goose egg could be felt. It seemed to occupy the ampullary region of the tube or ovary and was but slightly movable. A cast which proved to be a hyperplastic endometrium was passed by the vagina, but no decidual cells could be demonstrated. Since the pelvic condition remained unchanged, an operation was performed. There was no free blood in the peritoneal cavity, the uterus was not enlarged and was in midposition, but the left ovary was transformed into a dark, tense cyst the size of an apple. The left ovary

⁶⁰ British Medical Journal, 1918, p. 590.

⁶¹ Ibid., p. 84.

⁶² Journal of the American Medical Association, 1918, lxx, 295.

and the appendix were removed followed by dilatation and curettage and Willis's operation for shortening the round ligaments. The patient recovered and menstruation was resumed in a normal manner.

How Much Ovarian Tissue Shall Be Removed? The question of removal of one or both ovaries at the time of hysterectomy or other pelvic procedure has been a much debated point. That ovarian secretion has an important influence on the female nervous system has become an established fact; hence the prevailing tendency to conserve ovarian function as far as possible, and, if the glands are completely removed, to attempt to supplant their loss by means of transplantation or organotherapy. Osborne⁶³ believes that total removal of both ovaries is justifiable only under very rare circumstances, and he makes it a rule, in operating for tubal and ovarian disease, to leave as much of the ovaries as may be found healthy. If the operation destroys the circulation and hence the nutrition of the whole of both ovaries, Osborne is in favor of placing grafts from the healthy portion of ovaries in some location where they may live and be properly nourished, and if there is no healthy tissue for autografting, a transplant is made from the healthy ovary of a suitable person. It is usually two or three months before the effects of the transplant are felt in the form of a general feeling of health, absence or diminution of menopause symptoms and menstruation. The seriousness of the symptoms, both physical and mental, following total ablation of both ovaries is bringing both ovarian transplantation and organotherapy into prominence.

In a previous paper on the advisability of the conservation of the ovaries in cases of hysterectomy or removal of the tubes, Polak summarized his views as follows:

1. That the technic of the operation and the general health of the patient has much to do with the end-results.
2. That a conserved ovary if unhealthy will leave the patient in a worse state mentally, nervously and physically than if total extirpation had been done.
3. That when the woman is at the age at which the menopause should occur or when she is past the menopause a total ablation gives the best results.
4. That the nervous phenomena are more marked when the patient is operated when she is in comparatively good health, with a high pre-operative blood-pressure, than when the blood picture shows anemia or toxemia.
5. That the symptoms of the operative menopause are less after extirpation for pelvic inflammation than when the ablation is done for fibromyomata. This is probably due to the associated vessel changes which we find with fibrosis, and finally when one or both ovaries can be conserved it should be done, especially if the menstrual function can also be preserved. The younger the patient the more necessary is this conservation, for we all must admit that, on general principles, the ovary should be preserved in operating on the female pelvis:

⁶³ New York Medical Journal, 1918, cviii, 451.

1. To preserve to the woman the possibility of future pregnancy—this means retention of the uterus and at least one tube or a portion of a tube and an ovary. Preferably, the conserved ovary and tube should be on the same side, for there are a number of cases on record of overgrowth of the fecundated ovum in its transit, with a resulting ectopic pregnancy, when the retained ovary was on one side and the conserved tube upon the other.

2. For the continuation of menstruation this presupposes retention of the ovary and uterus or a part of the uterus containing sufficient mucosa to functionate. The psychic effect of menstruation is more important to some women than the continuance of ovulation; this is especially so in young women, and the continuance of menstruation actually seems to prolong the life and functional activity of the retained ovary.

3. For the continuation of the trophic influence of the ovary, which is supposed to continue, provided the conserved ovary or portion of ovary continues to form ova and corpora lutea. It is chiefly with this class of ovary or ovarian tissue with which this study deals.

4. Finally, transplantation of the ovary may be done to reestablish the trophic influence of the ovary on the female organism. Here, as in preservation, some of our most laudable endeavors miscarry and the patient becomes the unlucky recipient of our mischosen conservation.

Since that time, Polak⁶⁴ has had an opportunity of making a careful clinical microscopical study of the life-history of these conserved ovaries in 73 cases in which re-operations were necessary for clinical suffering and subsequent disease in the retained ovary within five years of the primary procedure. Among the lesions found at the second operation were multiple cystic changes, cirrhosis, cystic formation, infection and thin-walled cyst with dense adhesions. In the study, constant reference was made to the previous operative history in order to eliminate any defect of technic or the retention of a grossly diseased gland which could not be expected to regenerate. The study includes not only cases of hysterectomy in which the ovary was retained with its tube, but also cases in which the uterus and one or both ovaries have been retained after extirpation of the tubes. Polak is still firmly in favor of ovarian conservation to assure the possibility of future pregnancy and for the continuance of the menstrual function even when conception is impossible, but the careful studies of the end-results in these 73 cases make him feel that routine conservation of the ovary or part of the ovary when the uterus has been removed is not always in the best interests of the woman's future well-being, his final conclusions as a result of these reoperated cases being as follows:

1. That routine conservation without due consideration of the ovarian and contiguous pathology as it exists in the individual case is not good teaching.

2. That regeneration of the conserved ovary depends largely on the type and duration of the existing infection and the condition of the tunica of the individual ovary.

⁶⁴ Transactions of the American Gynecological Society, 1918, xliii, 103.

3. That even when the most detailed technic is observed the ovarian circulation is impaired.

4. That the retained ovary without the uterus is always a focus for possible trouble.

5. That the life-history of the retained ovary is of short duration and that the trophic influence of the diseased ovary has been overestimated.

6. That a cured patient has few nervous symptoms.

Ovarian Auto- and Homografts. Little advance has been made during the past year in ovarian transplantation, principally because research workers have been concentrating their attention on the great problems of war surgery, and before we can hope for real success in this field, a great deal of work must be done on the internal secretion not only of the ovary itself, but of other closely related internal secreting glands. In some cases homografts, not autografts, must be employed to retard or modify the symptoms of the artificial menopause; and in order to make the former successful a means must be found of inhibiting the resistance of the host to the graft. A step in this direction has been made by Mauclaire⁶⁵ who advocates intra-omentum ovarian grafts.

By making the transplant within the lower edge of the omentum, not upon it, as advocated by Hertlitzka and Foá, the author has succeeded in placing the graft in a richly vascular tissue and also in one which will not absorb the graft. In some cases, after placing the grafted ovary in the omentum, Mauclaire fenestrated the latter and hemmed it about the ovary. In this method the secreted ova would fall into the pelvis and be absorbed. In some cases, however, the preserved tube was sutured to the grafted ovary so that the escaping ova might enter the tube and an intra-uterine pregnancy be possible. Out of 10 cases of intra-omentum ovarian autografts, in 8 cases menses were resumed, the periods being sometimes early, sometimes much deferred and the discharge varying in quantity.

This method was further employed in 6 cases of homografts, the grafted ovary being taken from patients operated upon for uterine fibroma in whom there was neither syphilis nor tuberculosis. Menstruation returned in 2 out of the 6 cases, the chief difficulty being, Mauclaire feels, that the donor was over forty in most cases and hence the ovary was too old. In summarizing the requisites for successful ovarian grafting, the following points are enumerated: to operate aseptically and dispense with a general anesthetic; not to contuse the ovary nor make fragmentary grafts; the bed of the graft must be highly vascular and the grafted ovary must be young. The recipient must be of the same species and race as the donor and should not be pregnant.

The whole problem requires much more investigation, and, at the present, I am inclined to believe that ovarian organotherapy is to open a much larger field of usefulness than ovarian transplantation.

Ovarian Organotherapy. The knowledge which is being constantly gleaned from experimental and clinical work in endocrinology promises much in the future in the treatment of a group of pelvic disorders which

⁶⁵ Ann. de gynec. et d'obst., xlii, 720.

are attributed to disturbances of the function of the ovaries, such as menorrhagia, amenorrhea, menstrual clotting of blood, dysmenorrhea, sterility, genital atrophy and various other nervous and vasomotor disorders caused by perverted functioning of the genital organs. The problem is greatly complicated by the very close inter-relation and interaction of the various members of the endocrine system and because of the present controversial results obtained by the administration of various active principles of these internal secreting glands. It is, however, only by careful correlation of the experimental and clinical results that progress is to be made in this new and very important field of medicine. Graves⁶⁶ has recently obtained striking results in a group of cases of functional disturbances after the administration of ovarian extracts. He used ovarian extract in three forms, his preference being indicated by the following order: (1) Ovarian residue, a dried preparation from the ovaries of pregnant animals with the corpus luteum excluded (Parke, Davis & Co). This is also put up in ampoule form for hypodermic use. (2) Extract of the whole ovary (Armour's). (3) Extract of corpus luteum (lutein tablets of Hynson & Wescott). The use of the first form, ovarian residue of pregnant animals, was the result of Graves's personal experimentation.

In a series of cases treated with corpus luteum of pregnancy, he found the substance had a decided toxic effect, and as a control, he used a similar preparation from which the corpus luteum had been removed. The results in the latter cases were striking, and toxic symptoms were entirely absent. These findings are supported by the interstitial cell theory of ovarian secretion, for while secreting interstitial cells are present both in the connective-tissue envelope of the follicles and in the corpus luteum, those in the former are by far the more active, particularly during pregnancy.

That there is a close relationship between disorders of ovaries and uterus and psychic disturbances has been recognized for some time by Kraepelin and many others. While psychic symptoms do occur in women whose pelvic organs are anatomically and physiologically normal, there are many cases of mental disorders in which there are abnormalities, either anatomical or functional, or both, in the genital organs. With the further development of our knowledge of the internal secreting glands and the close inter-relationship existing between them, we realize that this must be so, particularly since both the pituitary and the ovaries belong to this chain of organs. The frequent onset of mental disease at puberty or at menopause, and the occurrence of idiocy, and various mental disorders are well known facts and strongly prove a close bond between the condition of the female genitalia and that of the mind. Hoxie⁶⁷ has reported a case of a young woman, a University graduate, who had suffered from dysmenorrhea since the onset of puberty. After teaching school for two years her menstrual periods were accompanied by mental confusion of a melancholia type. Her physical condition was poor, there being a neglected pyelitis, cervicitis and constipation; these

⁶⁶ Medical Clinics of North America, 1918, No. 4, i, 935.

⁶⁷ Endocrinology, 1918, ii, 101.

conditions were treated, but it was not until corpus luteum was administered at her periods that the attacks entirely cleared up so that she could continue her work. The symptoms were attributed, therefore, to an atrophic condition of the ovaries which was counteracted by the corpus luteum administration.

The problem of choosing between ovarian extract and corpus luteum extract is not always easy. According to Osborne,⁶⁸ ovarian extract is indicated: (1) After extirpation of both ovaries; (2) for menopause symptoms, especially when the onset is abrupt; (3) for too slowly developing girls; (4) when there is an apparent subsecretion of the ovaries in older girls and women, especially when a long course of treatment is necessary; (5) in menstrual disturbances.

After the removal of the ovaries or after menopause, if there is evidence of subthyroid secretion, in slow heart action, low blood-pressure, and increase in weight, thyroid and suprarenal extract may be combined with ovarian, amounts to be carefully regulated according to the susceptibility of the patient. While ovarian extract is of undoubted value in some cases of dysmenorrhea, for the relief of nausea, headache, and pain, all local disturbing factors should be eliminated before glandular therapy is instituted. Among the indications for corpus luteum, Osborne gives: (1) Amenorrhea; (2) overweight; (3) dysmenorrhea; (4) pregnancy; (5) menopause cases.

Toxic symptoms rarely follow the administration of ovarian extract, while corpus luteum extract is an actively physiological and at times a toxic preparation, in the opinion of Osborne. Prolonged use of ovarian extract may cause a reduction of blood-pressure. The best ovarian extract is made from glands of pigs which are dried and put up in 2-grain tablets. From three to six tablets are given per day. Corpus luteum extract is also prepared from the glands of pigs, but is given preferably in the form of powder or in capsules, and the dose should be very small—at first, a half grain—and later gradually increased. Large or long-continued doses of corpus luteum extract may cause toxic symptoms, such as low blood-pressure, palpitation, nausea, vomiting and a general feeling of depression. Hence, it is advisable to have frequent blood-pressure readings made during the course of treatment. If the blood pressure is low in the beginning, a drop of over 5 mm. Hg should indicate a cessation of treatment for a time at least; if the blood-pressure is high in the beginning it may be allowed to fall 15 to 20 mm. before treatment is discontinued.

In spite of a large number of investigations upon the physiological effects of ovarian extracts, during the past twenty years, by Federoff, Livon, Vincent and Sheen, Biedl and others, the results are not entirely uniform, and before organotherapy can be placed upon a firm physiological foundation, more research is needed along these lines. The past year has brought forth the results of an interesting piece of work by Gonalons,⁶⁹ who has carried out a large series of experiments on the effects of macerated decoctions and extracts of ovaries without corpus

⁶⁸ Loc. cit.

⁶⁹ Surgery, Gynecology and Obstetrics, 1918, xxvi, 196.

luteum bodies and of the corpus luteum of the cow, various solvents, such as alcohol, ether, and chloroform being employed in making the extracts. The injections were made into dogs, rabbits and toads. No difference was found in the action of the gravid and periodic corpus luteum; decoctions were more active than macerations in the case of both the corpus luteum and the ovary. Fluid of ovarian cysts was found to have no action.

Immediately following the injection of doses of 20 c.c. of maceration or decoction of gravid corpus luteum, at 1 to 4 or 1 to 5, there was a marked and rapid hypotension of 50 to 80 mm. Hg. The pressure fell rapidly, the pulse weakened, and there were sometimes deep convulsive respirations during the first few moments. After one to three minutes the pulse strengthened and the pressure rose, returning to normal in most cases in five to ten minutes, while in a few cases it persisted slightly diminished. The hypotension obtained from maceration or decoction of the ovary, while often reaching as low a level, was less durable and cardiac weakness less pronounced. Respiration in both cases was momentarily accelerated, then returned to normal or remained slightly diminished in amplitude. The hypotensive action of both ovarian and corpus luteum extracts was observed as above described after a previous vagotomy and also after previous atropinization of the animal.

Injection of these extracts in guinea-pigs caused a marked hyperemia of the intestine, uterus and its adnexa, and of the breast in cats and humans. Peristaltic contractions of the intestines were observed in rabbits and when the action of these substances was tested on an isolated intestine there was a marked strengthening of tone and rhythmic contractions. The effect on the stomach was described as an initial inhibition of rhythmic contractions of short duration, followed by a marked strengthening of the contractions. The injections caused marked hyperemia of the uterus, and when an isolated uterus was placed in Ringer-Locke solution the extracts produced a toxic contraction, with increase of the rhythmic contractions. Decoction of the gravid corpus luteum had a strong inhibitory action on the tone and rhythmic contractions at 1 to 2000 in 7 per cent. NaCl solution; with stronger doses there was complete paralysis. Gonolons has found both experimentally and therapeutically that the corpus luteum of the pregnant cow has a marked galactagogue action. He advises a daily dose of 0.05 gm. (0.10 the first day and 0.05 on subsequent days) of powdered corpus luteum of young heifers.

FALLOPIAN TUBES.

Anomalies. Anomalies of the Fallopian tubes are not common; however, another has been added by Metcalf,⁷⁰ who found two lumina in a tube removed from a patient whose ovary on that side had been enlarged, inflamed, and closely bound down by adhesions. At the uterine end the tube was normal, but midway between the uterus and the fimbriae the tube became swollen and at the fimbriated end was twice its

⁷⁰ Journal of the American Medical Association, 1918, lxx, 20.

normal size. At the uterus the opening was single, but it gradually became double through the formation of a partition. A short distance from the ovary, one of the lumina became smaller and drew away from the other or main opening, and ended in one of the fimbriæ some distance from the main opening of the tube.

Tumors. Fibroma of the Fallopian tube is comparatively rare. In a careful search of the literature, Herde⁷¹ was able to find only 20 such cases, and none with the tumor located at the abdominal end of the tube. In the case reported by him, the tumor was in this location and caused no symptoms until torsion of the pedicle brought about a severe illness simulating that caused by an acute appendicitis.

Infection. The question of the extent of the operation in cases of infection of the Fallopian tubes always demands careful consideration and decision depends largely upon the type of the infection and the age of the patient. If the infection is of gonococcal origin the hope of future pregnancy is practically *nil*, and I think most of us feel, as Warner⁷² has recently expressed himself, that the operation should be as extensive as the condition may require. When the infection is due to other organisms, as, for example, the streptococcus occurring after abortion, Warner feels that in young women without children the tubes should not be disturbed unless dangers from purulent inflammation are imminent. If an operation is performed and the patient is young, it should be sufficiently conservative so that future pregnancy is not prohibited. In older women pus tubes should be completely removed. When an ectopic pregnancy occurs in a young nullipara, the removal of one tube is indicated; when it occurs in a multipara, the removal of both is strongly indicated, for both are probably divested of their ciliated epithelium which will render probable a like pregnancy in the remaining tube.

Grad⁷³ has recently made a statistical study of 100 cases of pyosalpinx. Clinically, the cases were divided into the three following groups: (1) Acute purulent salpingitis; (2) subacute purulent salpingitis; (3) acute recurrent purulent salpingitis. Grad feels that the differentiation of these three types is one of the utmost importance, since in the acute cases operation gives a better prognosis if it be deferred sufficiently long for the individual to develop an immunity, while in the subacute and the acute recurrent cases immediate operation is the safe and wise procedure. In the acute cases, the following line of treatment is carried out at the Woman's Hospital in New York City: "If a patient comes to our wards with an attack of acute pyosalpingitis, when the infection is of recent date, he is put to bed, an ice-cap is placed on the abdomen and the case is treated purely on symptomatic lines. Of late, instead of applying ice-bags we have been baking these cases with dry hot air, with considerable success. Should the septic absorption be very severe, as indicated by sharp rises of temperature and chills, an attempt will be made to reach the focus of pus by the vagina. If this is not feasible,

⁷¹ Cor. Bl. f. Schweize Aerzte, 1918, xlviii, 706.

⁷² Medicine and Surgery, 1918, ii, 731.

⁷³ American Journal of Obstetrics, 1918, lxxvii, 630.

nothing further is done surgically. The nutrition of the patient is kept up as is consistent with the capabilities of the digestive function. The bowels are moved with enemata, the pain is relieved with anodynes, and as much fluid is given as can be taken by the patient. As these women always suffer from a certain degree of acidosis, this is combated by the proper administration of alkalies. The blood reaction to the inflammations is estimated frequently. The case is not hurried to the operating table until a reasonable time has elapsed, during which time we feel sure that a certain amount of immunity has developed. This is estimated by the fact that although the abdomen is still rigid and the pelvis filled with inflammatory reaction, the temperature has a tendency to reach the normal. The pulse has become more steady, the patient's suffering is less, sleep has returned and the patient looks as though she were steadily improving. When this stage has been reached there is greater safety in operation than during the acute onset of the disease."

On the other hand, immediate operation is advised in the subacute and the acute recurrent cases, the important question being: How extensive shall the operation be? In 62 per cent. both Fallopian tubes were ablated. In 15 per cent. only one tube was removed. In 18 per cent. the uterus, both tubes and ovaries were removed. In 43 per cent. one ovary was removed at the time of the operation for pyosalpinx. Both ovaries were removed in 18 per cent. of the cases. The appendix was removed in 28 per cent. In 8 per cent. one or more plastic operations were also performed, such as trachelorrhaphy and perineorrhaphy. Three times the round ligaments were shortened at the time of the operation. In only 5 per cent. of the cases was vaginal section done when pyosalpingitis was diagnosed. In 26 per cent. of the cases the uterus was curetted at the same time. In 2 per cent. a myomectomy was performed.

As to the advisability of hysterectomy, Grad feels that the surgeon must decide this question according to the conditions of the individual case. When both tubes are involved, the uterus is usually also infected so that its removal should be of advantage to the patient. However, the condition of the patient may demand a short operation, or the technical difficulties may be such that it is wise to leave the uterus untouched. As to the removal of the appendix, this is not advisable if one is operating in an acute case, for an undamaged peritoneum can cope with infection much better than a traumatized one. However, in the subacute and the acute recurrent cases, the appendix should be removed if it is diseased or appears abnormal in any way for the pus in these cases is usually sterile and the removal of the appendix, therefore, does not enhance the dangers of the operation. No drainage was deemed necessary in 50 cases. In 43 cases the pelvis was drained by the vagina, in 6 cases by the abdomen, and in 1 case by both routes. Of the 43 cases drained from below, the abdominal wound broke down in 6 cases, or 14 per cent. In the 6 cases of drainage above, the wound healed firmly in every case.

There was one death in the series, making a mortality of 1 per cent. This was a serious case from the beginning, the patient having a large

tuboövarian abscess. A double salpingo-oöphorectomy and appendectomy was performed, but she died thirty-six hours after operation. The recovery from operation was smooth in 85 per cent., while in 15 per cent. of the cases there was a rise in temperature and pulse, and distention of the abdomen. The patients left the hospital on an average of two and a half weeks after operation.

VAGINA.

Construction of an Artificial Vagina. Most of the cases reported in literature up to the present time, in which intestines have been employed to line the new vagina, have followed Baldwin's method of applying a loop of the ileum, with the exception of Wallace's case, in 1911, in which a single limb of the sigmoid was employed. Inasmuch as the ileum may be distended to the diameter of 1.5 inches without injury to its coats and since one side of the loop is just as long as the loop itself, Abbott⁷⁴ devised the idea of using a single limb of an ileac loop and applied his method with success in the case of a young woman who had never menstruated. The procedure was described as follows:

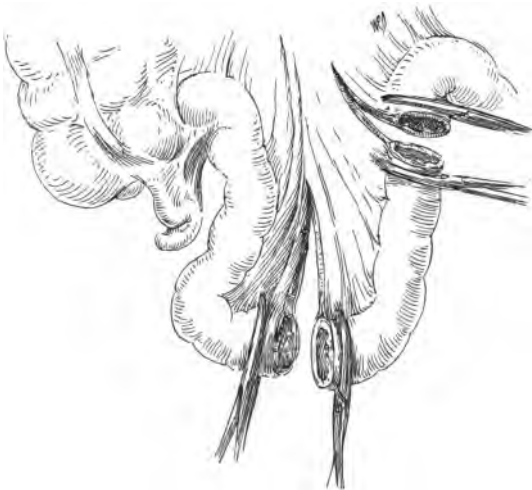


FIG. 61.—(Abbott.)

"A vertical incision was made through the little vaginal cul-de-sac. After finding the loose connective tissue separating the vagina and rectum and following it as far as the pelvic peritoneum the opening was enlarged laterally by stretching to two inches. The cavity was filled with iodoform gauze. A low median incision was then made in the abdominal wall and a suitable loop of ileum selected. This, at the distal base of the loop, was in this case about 9 inches from the ileocecal valve. Two clamps were applied at the extreme end of the loop and two at the base of the loop on the proximal side, and the gut divided between the clamps at both of these points (Fig. 61). End-to-end anastomosis

⁷⁴ Surgery, Gynecology and Obstetrics, 1918, xxvii, 227.

of proximal and distal opening with suture of mesentery was done, leaving a single leg of the gut with a clamp at each end and then suture

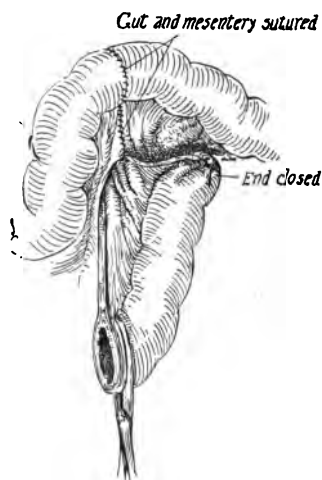


FIG. 62.—(Abbott.)

and inversion of the upper end, with the clamp still on the lower end (Fig. 62). The gauze, in the new vagina, being removed, a long curved



FIG. 63.—(Abbott.)

forceps was carried through the vulvar opening, down the new vaginal tract and forced through the peritoneum at the lower end of the new

vaginal opening (Fig. 63). This opening was sufficiently enlarged, the forceps was applied to the bowel replacing the clamp controlling the lower end. The gut was now drawn through the vaginal opening to the vulva and the abdominal wall closed. The lithotomy position was resumed, the gut sutured around the vulval opening (Fig. 64), and its lumen filled rather tightly with plain gauze. The gauze was left in the gut for seventy-two hours. At the end of two weeks the patient was examined. There was a tendency to contracture at two points; first, at the vulval opening and second, where the gut passed through the peritoneum. Gradual dilatation and the use of suitable plugs readily overcame the tendency and she now has a satisfactory vagina, as shown by the x-ray obtained by using a soft rubber dam tube one inch in diameter filled with barium and inserted in the vagina. A larger tube, if available, could have been used. There is no excessive discharge or odor."



FIG. 64.—(Abbott).

The author believes that the use of one limb of the intestinal loop instead of both possesses certain advantages; it takes less of the bowel, it requires the closure of only one end of the utilized limb instead of both ends of the loop, and it obviates the necessity of a second operation to divide the septum. It is not, according to the author, a difficult procedure for those accustomed to abdominal surgery, but it requires great care and accuracy as all such surgical procedures do. There is not much choice between the sigmoid and the ileum, except that Abbott considers the use of the latter easier and safer.

Complete Atresia and Disappearance of the Vagina in a Multipara. While numerous cases of atresia in old women have been reported, no records could be found in the Library of the Surgeon-General of complete atresia

with absorption of the occluded vagina. Baldwin's⁷⁵ case is, therefore, unique. His patient, a woman, aged fifty-eight years, was the mother of eight children and all her labors had been normal. She had been having bladder trouble for several years, which, upon examination, seemed to be due, in part at least, to the pressure of an enlarged and tender uterus. Outward examination showed no evidence of the presence of a vagina. An abdominal pan-hysterectomy was performed in the usual manner with the exception that after incising and separating the peritoneum, it was found that the cervix was simply held by connective tissue, and that there was no trace whatever of a vagina present. The peritoneal edges of the opening were whipped together with continuous catgut and the abdomen closed. On examination of the uterus, it was found that the cervix was occluded throughout its entire length and that the distention of the uterus was due to a collection of pus. The patient made a good recovery.

Operative Procedures on the Vagina. Bissell⁷⁶ has slightly modified the Emmet-Baldwin operation for *procidentia uteri* of long standing and *cystocele* by effecting fascial reinforcement through the lapping of the fascia of the anterior vaginal wall and approximating the cardinal ligaments. The technic is described by Bissell as follows: The usual circulation incision was made around the cervix at its juncture with the vaginal mucosa. The tissues were separated from the cervix to a limited extent and the cardinal ligaments were penetrated and tied with No. 2 chromic catgut. As the free ends of these sutures were to be used at the end of the operation, a forceps was attached to each group. The anterior vaginal wall was now incised in its middle from a point immediately below the vaginal trigone to the uterovesical area and through the mucosa and fascia. The bladder was next completely separated from the fascia of the anterior vaginal wall and from the anterior surface of the cervix. Posteriorly, the tissues were likewise separated from the cervix. Anteriorly, the peritoneal reflection was incised. Posteriorly, the peritoneal reflection was not incised. The corpus uteri was delivered through the anterior peritoneal opening and a strip of gauze, to which was attached a piece of catgut, was passed into the peritoneal cavity to protect the intestines and prevent them from protruding. The fundus was now brought forward to the vulva; when the cervix is not too large, it should be returned to the vagina, but in the cases here cited the cervixes were greatly hypertrophied, and the operation was completed with practically the entire organ out of the vagina. The corpus was removed from above downward as is done through the abdominal route. When the corpus was severed from its broad ligament attachments, there remained only the thin posterior septum attached to the cervix. Before cutting this last connection, the index finger was passed posterior to the cervix to direct the incision. The next steps were adopted to prevent a recurrent prolapse of the vaginal vault and the bladder, and involved a principle similar but differently applied to that presented in a preliminary report by Reginald Rawls, of an operative procedure for

⁷⁵ Surgery, Gynecology and Obstetrics, 1918, xxvi, 463.

⁷⁶ American Journal of Obstetrics, 1918, lxxvii, 892.

the cure of cystocele and the lapping of the anterior vaginal fascia (Fig. 65). The two flaps of the anterior wall were now treated in the following manner:

Each flap was trimmed longitudinally to practically one-half its original size and from the right flap, or that to the left of the operator, the mucosa was removed, leaving it an irregular quadrilateral area of fascial structure. This flap was severed crosswise in the immediate region of the trigone to the extent of about 1 cm. so as to permit of an exact adjustment of this flap when its free longitudinal cut border was transferred and anchored under the opposite flap. Four mattress sutures were used to anchor the denuded flap. The first suture penetrated the undenuded flap from without in, where the lateral vaginal wall met the anterior wall and on a line with the anterior limits of the vaginal trigone. It was then made to penetrate the denuded flap at its upper angle from without in and from within out at $\frac{1}{2}$ cm. or more from

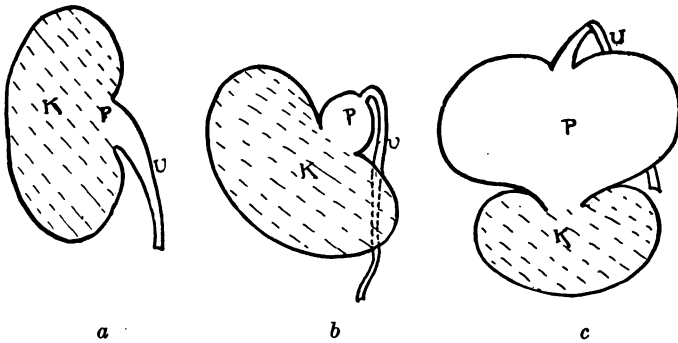


FIG. 65.—A schematic drawing, showing the evolution of Case I and of Chetwood's case. *a*, shows the kidney and ureter in normal position and condition; *b*, shows kidney prolapsed without a corresponding change in the position of the ureter with resulting angulation and slight distention of the kidney pelvis; *c*, shows a stage of further prolapse of the kidney but no change in position of the ureter with resulting acute angulation of the ureter and marked distention of the kidney pelvis. (Bissell.)

the longitudinal cut border of the flap. The suture was then made to penetrate again the undenuded flap, but from within out near its original entrance. The lower angle of the denuded flap was prepared in a similar manner, the suture finding its point of anchorage to a stable area of the vagina in the region of the white line. Two or more mattress sutures were placed between these two points, so as to straighten out and fix the free longitudinal border of the flap when the sutures were tied. Three or more interrupted sutures of chromic gut or kangaroo tendon were now passed through the free longitudinal border of the undenuded flap at the meeting of the mucosa and the fascia. The suture which penetrated the lower angle of the undenuded flap was tied first. After the interrupted sutures were tied, a continuous suture of chromic gut was used to complete the adjustment of the undenuded flap. One strand of each chromic-gut suture surrounding each so-called cardinal ligament was utilized as a running suture along the posterior cut surface of the vaginal vault to prevent hemorrhage, which not infrequently

occurs from this surface. The remaining strands were now tied to approximate the cut ends of the cardinal ligaments. These latter sutures were used again and made to penetrate the newly constructed anterior vaginal wall from within out at its lower border and tied to the sutures passed through the posterior vaginal wall. Before tying these sets of sutures, a narrow strip of iodoform gauze was passed into the posterior vaginal space. Iodoform packing in the vagina completed the operation.

Bissell⁷⁷ recommends this same principle and almost the same technic for the cure of cystocele and rectocele. In these cases, it should be borne in mind that the fascial structure of the posterior vaginal wall merges with the inner border of the perineum and extends laterally to the levator ani muscles and posteriorly to the cervix. Under normal conditions this fascia is not thick, but in case of abnormal pressure, as in the rectocele and the cystocele, there is marked thickening. In operating for rectocele, Bissell proceeds as follows:

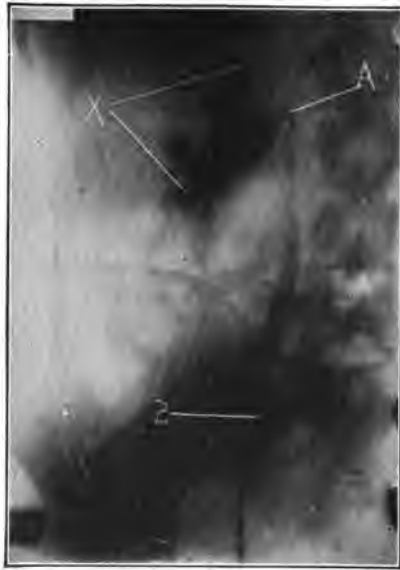


FIG. 66.—Chetwood's case before operation. Illustrates a constriction in the upper urinary tract. The kidney here has prolapsed but the ureter has not, and in consequence we have an angulation of the ureter at the point where it fails to descend. (Bissell.)

"To correct an accompanying rectocele a median longitudinal incision is made through this fascia into the cellular area which determines the line of demarcation between the vagina and the rectum. This cellular tissue is now separated from the under surface of the fascia, laterally to the levator ani and longitudinally to the cervical area. This cellular tissue may at times be found to contain a considerable quantity of fat, as in the case reported. As the freeing of the cellular tissue from the fascia is continued in the direction of the cervix, the incision is extended

⁷⁷ American Journal of Obstetrics, 1918, lxxviii, 1.

to within 1 cm. of the cervix. The vaginal flaps are now prepared for lapping by first trimming them longitudinally to an apparently excessive degree. The extent of this trimming must depend, of course, on the amount of redundant tissue or size of rectocele. Roughly speaking, only about one-half of each flap remains, and the effect produced after completing the operation is that of overcorrection (Fig. 66). The flap to the left of the operator is now carefully denuded of its mucous membrane. Scissors are used to make the denudation, as by their careful employment, a thin submucous layer of tissue is left upon the fascia which serves to maintain the fascial continuity of the flap. The flap thus being made relatively thick, resists the strain of the stitches better than the fascia alone would do. The denuded flap is now severed crosswise immediately below the cervix to the extent of about 1 cm. This is done in order to make a better fascial approximation when the flaps are overlapped. The next step is to place the sutures so that the denuded flap will be anchored well under the undenuded flap. The first mattress suture should penetrate the undenuded flap from without in, where the posterior and lateral vaginal walls meet. It is then made to penetrate the denuded flap at its proper angle from without in and from within out at $\frac{1}{2}$ cm. or more from the longitudinal cut margin of the flap. The suture is then made to penetrate again the undenuded flap, but from without out, near the point of its entrance. Four or five mattress sutures of chromic gut 1 cm. or more apart are inserted in like manner, which when tied complete the anchorage of the denuded flap. The object of leaving so much tissue to the inner side of the sutures on the denuded flap, is to extend the fascial union to an area beyond the anchorage.

Three or more interrupted or mattress chromic gut sutures are now passed through the free longitudinal border of the undenuded flap and again through the fixed border of the denuded flap where the mucosa and the fascia meet. A continuous chromic gut suture is then used to approximate the cut mucous edges."

Repair of Complete Rectovaginal Lacerations. Haynes⁷⁸ has recently described an operation which he performed in January, 1916, for the repair of a total division of the rectovaginal septum from the cervix to and through the perineum. While his method is very similar to that described by Lignen, in 1903, for the treatment of high rectovaginal fistula, the literature on the treatment of complete rectovaginal lacerations is so scanty, that the steps of Haynes' operation, which are essentially as follows, deserve our attention:

1. Begin the separation of the rectum from the vagina just above the levatores ani and in the space between the rectovaginal fascia and the rectum.

2. Separate the bowel downward through the anal canal and cut through the mucocutaneous junction. Carry the mobilization of the bowel upward high enough to obtain sufficient sound rectum so that the undamaged rectum may be drawn beyond the level of the skin.

3. Divide the anococcygeal tissues sufficiently far toward the coccyx

⁷⁸ *Annals of Surgery*, 1918, lxvii, 501.

to permit suturing the retracted sphincter ani externus in front of the rectum.

4. Rotate the rectum through 90 degrees and suture it in place, especially reforming the attachments of the levatores ani to the bowel. Trim off the excess of rectal tissue and suture the skin to the rectal mucosa. Drain the region behind the rectum.

5. Complete the operation by perineorrhaphy.

Tumors of Vagina and Cervix. Adenomyoma of the cervix and vagina is not so rare as has been hitherto supposed. According to Curtis,⁷⁹ who has recently seen two such cases, the tumor takes its origin most commonly from the region of the cervix and grows posteriorly, invading the cul-de-sac and adjacent tissues in a manner similar to carcinoma, but less malignantly. In one of his patients, a woman, aged forty-seven years, who had suffered from menorrhagia for years, examination revealed a congenital ring in the vagina, a large uterus fixed in retroversion, and a longitudinal polyp-like, bean-sized nodule projecting downward, evidently from the cervix into the cellular tissues of the posterior cul-de-sac. An operation was performed by another surgeon for the former conditions, but the nodule in the cervix remained and gradually increased in size, invading the vaginal septum and bursting through the vaginal wall into the posterior fornix. At operation, the cervix, tumor and invaded tissues were removed by the vaginal route. Though adherent to the rectal wall, the growth had not invaded it and the patient made a complete recovery. Microscopic examination showed the tumor to be an adenomyoma with no sharp line of demarcation between it and the cervix.

In spite of the fact that HYPERNEPHROMA is potentially a malignant tumor and that metastasis is the rule, and in spite of the close relation between the urinary organs and the genital apparatus in the female, vaginal metastases of hypernephroma are exceedingly rare. Gellhorn⁸⁰ was able to collect but 9 such cases, to which he adds a tenth case of his own. In Gellhorn's case, in a woman, aged fifty-four years, a large retroperitoneal tumor on the left side was found whose nature could not be determined. Vaginal examination revealed the presence of two growths in the anterior vaginal wall near the introitus. These growths were of the size and shape of raspberries and were easily shelled out with the finger-nail. Microscopic examination showed typical hypernephroma. It was then assumed that the two vaginal growths were metastases of the obscure retroperitoneal tumor and that the latter was a hypernephroma of the kidney. The patient died suddenly a few days later and autopsy confirmed the correctness of the diagnosis.

One of the interesting features in Gellhorn's case is the fact that diagnosis of the primary growth was made possible by microscopic examination of the vaginal metastases. Gellhorn believes that many of the malignant tumors of the vagina considered to be primary are in reality metastases, and, if this point is borne in mind, the bad prognosis of the malignant growths of the vagina will at least be explained. He

⁷⁹ Surgery, Gynecology and Obstetrics, 1918, xxvi, 553.

⁸⁰ American Journal of the Medical Sciences, 1918, clvi, 94.

even believes that microscopic examination of many supposed sarcomata or carcinomata would show them to be hypernephromatous in nature, and that further investigation might often reveal the primary tumor in the kidney.

Exfoliative Vaginitis. True exfoliative vaginitis is sufficiently rare to warrant the mention of two very interesting cases recently reported by Kervin.⁸¹ In his first case, the patient, aged thirty years, had had one normal confinement nine years and one miscarriage six months prior to the expulsion of the first sac, and had had a fibroid enucleated from the angle between the cervix and body of the uterus, and a chronically inflamed appendix removed. The passage of the first sac caused little discomfort aside from a few cramps. Upon examination, nothing abnormal was detected, except a highly colored vagina. During the next year forty casts were passed at intervals of one to three weeks, each sac being a complete cast of the vagina. Their expulsion seemed to have no relation to menstruation, sexual intercourse, douches, excitement and the like. In his second case similar casts were passed, and their expulsion was unaccompanied by symptoms. In most of the cases thus far reported in literature, it seems evident that an exfoliation of true membranes has taken place, but these cases of true exfoliation must be carefully differentiated from those of a pseudomembranous exudation in which a pyofibrinous coating is found on the vaginal mucosa.

Various explanations have been given for these cases of exfoliative vaginitis, but none seem altogether convincing. Some authors consider it to be combined with exfoliative endometritis or membranous enteritis, or severe inflammation following masturbation, but the majority attribute it to thermic or chemical irritation from douches of too high a temperature or containing an excess of caustic ingredients. The possibility of bacterial infection or pathological changes in the deeper vaginal tissues is suggested by Kerwin, but the smears made from his cases showed nothing unusual. The diagnosis is not difficult, since the vagina shows very typical changes. Before separation of the cast the vagina assumes a whitish appearance, the changes usually appearing near the vulva at first. Bits of membrane can be picked from the vaginal wall, leaving behind them a bleeding surface. When the cast is thrown off, the new mucous membrane, which has already formed, appears highly colored. It may be easily differentiated from exfoliative endometritis, since the vaginal casts are larger and have two openings, but the two conditions may occur simultaneously. Pathologically there is a superficial necrosis of the vaginal mucosa before the expulsion of the cast. Microscopic examination of the casts shows that they are composed of vaginal epithelium.

Vaginitis in Children. The discovery of the gonococcus of Neisser and the various methods for combating it have by no means solved the problem of vaginitis in children. While it is an established fact that true gonorrheal infection does occur in children, the gonococcus

⁸¹ Surgery, Gynecology and Obstetrics, 1918, xxvii, 151.

having been recovered from metastatic foci in joints, in the eyes and other places; nevertheless, the occurrence of a true infection in very young children is probably very rare according to Rubin.⁸² This is in accord with von Pirquet's experience, who reports only 5 or 6 cases yearly in his large clinical experience. In Rubin's report, based on the careful study of 255 cases of vaginal discharge in children from the special clinic for vaginitis in children at the Mt. Sinai Hospital, he has come to the conclusion that if the majority of children having vaginal discharge are infected with the gonococcus, it must in all probability be a different microorganism from the one described by Neisser as occurring in adults. For the solution of this problem, careful and complete bacteriological studies, including animal inoculation, are essential. In 255 studies, only the smallest number appeared truly gonorrheal from their clinical aspects. A definite history of contact infection was found only in 1 case, evidence of a ruptured hymen without history of assault was present in two instances. In most of the cases gonorrheal ophthalmia, urethritis, joint and peritoneal symptoms were entirely lacking. This makes one feel that the vaginal catarrh, which sometimes spreads so rapidly through the children's wards of hospitals, may have a bacteriological etiology quite different from the Neisserian gonococcus. Louise Pearce's work in 1915 pointed toward this conclusion; she found that strains of gonococci from children and from adults differed so uniformly, both in agglutination and complement-fixation tests, that there seemed to be two distinct types corresponding to their clinical source.

Rubin feels that these points should be continually borne in mind, and that we should employ other and more scientific methods of bacteriological diagnosis and not depend solely upon the smear, since there is often the greatest discrepancy between smear reports and the clinical picture. The great majority of children are in hospitals for one of the exanthematous diseases; these are often accompanied by some desquamation of the vaginal mucosa, and secondary invading microorganisms may propagate in the discharge, particularly the micrococcus catarrhalis which is often difficult to distinguish from the gonococcus in smears, the streptococcus, pneumococcus and meningococcus, all of which may set up a vaginitis with a purulent exudate. Rubin feels convinced that the vaginal discharge in infants and small children is due far more often to these organisms than to the gonococcus. He also feels that in infants it is quite possible that during fits of crying the hymenal orifice may open and close and not infrequently due to improper cleansing, the colon bacilli or other organisms may be aspirated into the vaginal canal. Hence the importance of most thorough study before a diagnosis of gonorrhea is made in young children and specific treatment instituted. The essentials for such a diagnosis are a purulent discharge from the vagina, the discovery of the intracellular gram-negative diplococci of Neisser, the growth of this organism on suitable media, together with agglutination and complement-fixation tests in all cases of doubt.

⁸² Boston Medical and Surgical Journal, 1918, clxxviii, 147.

Absorption of Drugs and Poisons through the Vagina. As a war time contribution which may assist in the lowering of both maternal and infant mortality, Macht⁸³ has been carrying on a series of investigations in the Pharmacological Laboratory at Johns Hopkins University on the absorption of drugs and poisons through the vagina, and has reached the following conclusions:

1. It has been shown that a large number of drugs and poisons—alkaloids, inorganic salts, esters and antiseptics—can be and are easily absorbed through the vaginal wall.

2. Such absorption can be demonstrated experimentally by physiological and chemical means.

3. A review of the clinical and toxicological literature shows that poisoning through the vagina, of a grave character, is not very rare.

4. The above described experiments indicate, on the one hand, the possibility of administering drugs therapeutically for their constitutional effect, through the vaginal route; and on the other hand, emphasize the great danger of the indiscriminate employment of various poisonous substances in the form of douches, tampons, "uterine wafers," etc.

Relation of Pelvic Disorders to Mental Disease. Part I of the new edition of Graves's⁸⁴ book is devoted to the physiology of the pelvic organs and their relation to the different elements of the general organism, including the various glands of internal secretion. This section gives the results of recent investigations in this still undetermined field. An abstract of Loeb's recent work on the corpus luteum appears in this connection; also the very interesting results of ovarian transplantation. The question of organotherapy also is discussed to some extent in this connection. The author makes one feel the close relationship which really exists between the work of the gynecologist, and that classed specifically under neurology and psychiatry. He quotes Havelock Ellis as saying, "These facts of morbid psychology are very significant; they emphasize the fact that even in the healthiest woman, a worm, however harmless and unperceived, gnaws periodically at the roots of life." In the second part, too, an entirely new section has been added, presenting the relation of gynecology to the Freudian theory of sexuality.

A further proof of the relation between changes in the ovaries and mental disease is furnished by some very excellent histological studies by Laura Forster.⁸⁵ By making serial sections of the ovaries in a large group of mental cases, Forster has correlated the changes in these glands with the mental condition. In a series of dementia precox cases signs of early involution marked by increase in interstitial connective tissue and great scarcity of Graafian follicles were found in all those over thirty years of age. Even below this age there was a distinct diminution of follicles as compared with those of a normal woman of the same age. In cases of melancholia a definite diminution of follicles with some cystic degeneration and usually some increase in interstitial

⁸³ *Journal of Pharmacy and Experimental Therapeutics*, 1918, x, 509.

⁸⁴ *Loc. cit.*

⁸⁵ *Dementia Precox Studies*, April 18, 1918, p. 79.

connective-tissue stroma were demonstrated. In the general paresis cases, with the exception of those of the juvenile type, there was a decrease in the number of follicles, a marked increase in fibrous tissue and thickening of the vessel walls. On the basis of these findings, the author concludes that there is a definite relation between the ovaries and the brain, between certain types of mental disease and morbid changes in the ovaries. The study would seem to show that the normal maturation of the follicle and formation of the corpus luteum tend to cease and be replaced by degeneration of the follicle with the onset of certain types of mental disease.

DeForest⁸⁶ reports a case of complete pelvic obstruction due to fibromyomata as the cause of a puerperal psychosis.

PREOPERATIVE AND POSTOPERATIVE CARE.

Postoperative Studies of Blood-counts, Blood-pressure and Hemoglobin. In an attempt to ascertain the exact time of onset and duration of postoperative leukocytosis, Meleney⁸⁷ has made a careful study of the blood count in 51 non-infective surgical cases in the wards at the Presbyterian Hospital. A variety of conditions were chosen. An ante-operative count was made on the afternoon before the morning of operation, a second count on the afternoon of the day of operation, approximately six hours after operation, and another count on each succeeding afternoon until it returned to normal or to the initial count. He found that in surgical cases undergoing operation without infection, the white cells increase in number, and about six hours after operation have more than doubled. The response seemed to be due almost entirely to the outpouring of polymorphonuclear leukocytes. There was a trivial rise in red blood cells after operation but in the subsequent ten days this was followed by progressive anemia with an average loss of about one-half million cells per cubic millimeter. In the clean cases the count fell rapidly and reached normal on the fourth day, while in infected or contaminated cases it fell much more slowly. Infection and contamination at operation, however, have nothing to do with the initial rise, but on the second or third day after operation they will tend to keep the count high. Meleney discovered, moreover, that normal individuals will produce a higher leukocytosis than abnormal types and, other things being equal, the count will be higher in those cases in which there are severe trauma to the tissues, considerable loss of blood and long anesthesia, particularly with ether.

As the result of a careful clinical study of blood-pressure and hemoglobin in postoperative shock, postoperative hemorrhage and post-operative cardiac dilatation, Polak⁸⁸ has come to the following conclusions:

1. There is a constant rise of 5 to 15 points in the hemoglobin readings following anesthesia with ether, when such anesthesia occupies

⁸⁶ American Journal of Obstetrics, 1918, lxxvii, 276.

⁸⁷ Annals of Surgery, lxxvii, 129.

⁸⁸ Surgery, Gynecology and Obstetrics, 1918, xxvi, 312.

more than thirty minutes. Consequently, allowance must be made for this rise in using hemoglobin estimations as a diagnostic sign in internal bleeding.

2. The erythrocyte count is also increased but its variation from the preoperative is so slight that it does not warrant any conclusions.

3. In the majority of cases there is a moderate fall in both systolic and diastolic blood-pressure following ether anesthesia. The blood-pressure returns to normal, that is to the preoperative reading, in twelve to forty-eight hours. The inhalation of oxygen after the withdrawal of the ether vapor diminishes this fall of blood-pressure but is only transient in its effect.

4. In cases of shock, especially when there has been much blood loss during the operation, the fall in blood-pressure is greater than after long operation without blood loss, dropping from 10 to 50 mm.

5. The pulse pressure is a better index of hemorrhage or cardiac failure than the systolic pressure.

There is a constant rise in the leukocyte count in hemorrhage, while the leukocytes fall in shock.

A series of observations on hemoglobin readings after gynecological operations have been made by Dunn and Wynne,⁸⁹ who have found that hemoglobin readings shortly after operation show very little change when compared with readings made before operation, even in cases of severe hemorrhage. The immediate postoperative reading often shows some increase over the preoperative reading. The lowest point of the hemoglobin curve was found usually from thirty to sixty hours after operation (a difference of less than 5 per cent. was not considered). The greatest drop in hemoglobin was usually during the first twenty-four to thirty-six hours, and was most rapid when salt solution infusions had been given. In the series showing only a slight loss of blood at operation, the hemoglobin readings were usually higher during the first twelve hours than those made before operation, and there was very little postoperative decrease at any time.

Magnesium Sulphate Solutions in the Treatment of Spastic Contractures of the Rectum and Sigmoid Colon. Through repeated sigmoidoscopic and roentgenological studies, Soper⁹⁰ has found that spastic contractures of the lower colon and rectum of varying intensity play an important part in the etiology of many cases of chronic constipation and of the gas pains and abdominal distention following operations on the abdomen and pelvis. The most frequent site for these contractures is the recto-sigmoid juncture, severe contractures at this point presenting a syndrome described by Soper as "sigmoido-spasm." A most obstinate form of constipation, Soper finds results from combined contractures and dilatations, *e. g.*, (a) atony of the rectum and sigmoid associated with contracture at descending colon; (b) contraction at rectosigmoid angle and atony of sigmoid loop; (c) contracture at splenic flexure and descending colon and atony of cecum. The contractures, he feels, are the result of disturbances in Meltzer's law of contrary innervation, a predominance

⁸⁹ Johns Hopkins Hospital Bulletin, 1918, xxix, 17.

⁹⁰ American Journal of the Medical Sciences, 1918, clvi, 205.

of stimulation occurring in the exciting or contractile phase. Reasoning on the basis of Meltzer's experimental work, which showed that solutions of magnesium sulphate produce an inhibitory influence upon peristaltic movements of the intestinal tract when the salt is given intravenously or applied directly to the mucosa, Soper has applied a saturated solution of magnesium sulphate directly to the contractures in a series of 220 cases. He applied the solution by means of cotton applicators through the sigmoidoscopic tube (knee-chest position), a diffuse pink color appearing in the mucosa within from ten to twenty seconds. Mild contractures disappeared in a few seconds. Moderate contractures required a minute or two, and in order to relax strong spasms a series of applications were necessary.

Of 80 cases of obstinate constipation, 68 cases were apparently completely restored to a condition of normal colonic function. The number of treatments required in these cases varied from ten to thirty applications given every second or third day. Five cases were complicated by inflammatory induration and distortion of the bowel at the rectosigmoid junction, consequently treatment was ineffectual. In 7 cases the contractures were overcome but normal colonic function was not restored. Of 72 cases of obstinate spastic constipation, *i. e.*, cases that were of long-standing but that had not been previously under his care, 64 were successfully treated with satisfactory restoration of bowel function. Eight cases were extremely neurotic individuals who could not stand the treatment, although no real pain is produced by it. There were 68 cases of obstinate spastic constipation, cases of long-standing constipation, but which presented contractures that were moderate in character, *i. e.*, that readily responded to treatment and required but from six to ten applications to restore good colonic function.

The patient is asked to return for treatment every second day, the interval between treatments being gradually lengthened. All purgatives and water enemata are discontinued; an oil enema may be used if the patient is unable to come for treatment at the proper time. If the contracture cannot be reached through the sigmoidoscope, 2 ounces of the solution may be injected by passing a soft rubber catheter through the sigmoid tube.

Roentgenological examination in a series of 6 cases of postoperative abdominal distention and gas pains showed that the colon alone was involved; sigmoidoscopic examination showed the presence of marked contraction in the rectum and lower sigmoid. In a series of 30 such cases an enema of saturated solution of magnesium sulphate was given according to the following technic: Three ounces of saturated solution of magnesium sulphate is introduced by means of the rectal tube passed 4 or 5 inches into the bowel, elevating the hips whenever possible, and having it retained as long as possible. This procedure may be repeated every day or several times a day if so desired. There was immediate relief in 24 cases. While the enema was usually retained only about five minutes, there were no toxic effects when it was retained for twenty-four hours.

Preoperative Treatment, with Special Reference to Purgation. In a recent paper, Peet⁹¹ has pointed out the many advantages of the simple enema over the various forms of preoperative catharsis so widely employed. The administration of cathartics on the night preceding operation is followed almost invariably by loss of sleep, psychic and physical weakness, loss of body and intestinal fluids, change in the bacterial flora of the intestine, hypotonicity of the intestinal wall and irritability of the rectum and lower colon. Postoperative thirst after such a preparation must necessarily be greater, and because of the greater irritability of the rectum, thirst cannot be relieved by the easiest and safest method. It is impossible, even with a powerful purgative, to eliminate all the intestinal products which might lead to putrefaction, since waste products are continually passing into the intestines. Moreover, attempts at sterilization by calomel and other drugs, Peet feels, are useless. While many organisms are carried out, there is a tendency to change in the bacterial flora, usually in the direction of multiplication of fermentative organisms.

Clinical evidence favors a change to the simple enema. For the past six years a careful study was made of patients receiving preoperative catharsis and those receiving the simple enema only. In the latter cases, postoperative thirst, nausea and vomiting occurred much less frequently, and the patients were in much better mental and physical condition at the time of the operation.

On the basis of an extensive clinical and experimental study, Alvarez⁹² goes a step further than Peet and advocates that even the simple preoperative enema be avoided unless absolutely necessary, that food be given as late as possible before operation and that water and solid food be given by mouth as soon after operation as possible, and that purgatives should be absolutely avoided both before and after operation. Alvarez sums up his reasons for avoiding purgatives before operations as follows:

1. Some of the purgatives owe their effects to the fact that they are irritant poisons that must be removed quickly from the body. Others act by interfering with intestinal absorption and by upsetting the balance of salts. In either case they bring about pathological conditions. The body is weakened and not strengthened.

2. We know now that the dehydration of the body and the upset in salt balance are bad, particularly before an operation in which there may be hemorrhage and vomiting.

3. With magnesium sulphate, there may be an increased amount of fluid in the bowel to disturb those who want it empty. In operations on the colon, liquid contents are harder to control mechanically than are solid masses.

4. There is an increased growth of bacteria. There is some evidence that there is an increased absorption of toxins, and a greater permeability of the mucous membrane to bacteria. Undigested food may be carried down into the colon to supply increased pabulum for the bacteria.

⁹¹ Journal of the American Medical Association, 1918, lxxi, 175.

⁹² Surgery, Gynecology and Obstetrics, 1918, xxvi, 651.

5. By weakening some parts of the bowel and making others more irritable, the even flow of material from stomach to anus is rendered impossible.

6. Whether from disturbances in motility, in absorption, in the circulation or in the bacterial conditions, there certainly is a tendency to flatulence and distention.

7. When the bowels must move frequently during the night, the loss of sleep is considerable. The purgation is particularly trying if the patient is wearing a large cast, has a broken leg, or other painful lesion which makes each resort to the bedpan an ordeal.

8. If the patient should happen to have some intestinal obstruction, a gangrenous appendix, a badly diseased Meckel's diverticulum, or adhesions forming around some pus, purgation may directly cause death.

9. Purgation makes the bowel react so poorly to drugs that there may be grave difficulties in meeting postoperative emergencies.

10. Emptying the bowel by starvation and purging makes the resumption of colonic activity much more difficult. The colon must be filled and distended to a certain extent before it will empty.

11. The fact that children and nervous women will sometimes begin vomiting during the night, before the operation, shows that the purge must be responsible for some of the postoperative nausea and vomiting. The ether adds the finishing touches to what was begun the night before.

These conclusions were reached as the result of a series of experiments on purged animals conducted by F. B. Gaylor and himself. They studied the effects of castor oil, magnesium sulphate, cascara, calomel, and tincture of jalap on rabbits, by excising segments of the intestines from five different points, placing them in warm oxygenated Ringer's solution and noting changes in the gradients of rhythmicity, irritability or latent period. Only mildly laxative doses were used; the drugs were given at noon and the animals killed next morning. The bowels were found injected, full of fluid and gas, sometimes atonic and flabby, often irritable here and there and inclined to contract down into hard white cords. When the segments were placed in Ringer's solution, their contractions were weak and irregular and they soon became fatigued. One of the most important points noted was the diminished sensitivity to the local application of drugs, some having to be increased one hundred times. Magnesium sulphate appeared to be the most objectionable from the surgical standpoint, since by preventing the absorption of water, it causes great distention of the bowels with fluid. Calomel and cascara did not cause such pronounced signs of poisoning and fatigue in the excised segments as did castor oil, magnesium sulphate and jalap. The segments from the calomel rabbits beat well with a large amplitude and slow regular rhythm. The gradient of rhythm showed irregularity only in the animals that had received castor oil. The latent periods of the segments showed marked deviations. Some segments showed an abnormally high degree of irritability with a very short latent period, others scarcely respond to the strongest current. Normally, the latent periods are graded from short ones in the duodenum to longer ones in the ileum. The engorgement of the mesenteric vessels and the injection of the intes-

tinal wall was quite sufficient to upset the delicate balance between the gases in the intestine and those in the blood.

Besides omitting the purgative the night before, Alvarez suggests that if the operation is not to be performed earlier than 10 A.M., a light breakfast may be eaten, in occasional cases, of course, fear and apprehension may lengthen the emptying time of the stomach. Enemas should be given only to those who are definitely constipated or who are to have an operation on the lower colon or on the pelvic organs. Furthermore, gas-oxygen should have preference over ether whenever possible, as its effects on the digestive tract are much less. The importance of giving solid food as soon as possible after operation is strongly emphasized by Alvarez, because of its tonic effect on the tract, but cellulose should be avoided. The postoperative use of purgatives is quite as bad as their preoperative administration.

Ochsner⁹³ is still in favor of emptying the alimentary tract the night before operation by means of a large dose of castor oil and a large enema, and from this time until the operation the patient is to receive only broth so that no further decomposing material shall be introduced into the gastro-intestinal tract. After operation, according to Ochsner's routine, a soap-suds or normal salt enema is given each morning, except in peritonitis and in operations on the stomach or intestines; castor oil is given on the tenth day after operation. Hot water is given by mouth and proctoclysis directly after operation. On the third day after operation the patient is given broth, beef tea or gruel.

FEMALE URINARY ORGANS.

Ureteral Stricture. Ureteral stricture, or narrowing of the ureteral lumen, due to intrinsic inflammatory changes in the ureteral wall, is a disease far more common and of vastly greater importance than the literature or our previous experience has led us to believe, states Hunner,⁹⁴ in presenting a paper based upon an experience with over 150 cases of this condition. According to him, the majority of ureteral strictures, excluding those of tubercular origin, should be classified as simple chronic stricture, and they have their origin in an infection carried to the walls of the ureter from some distant focus, such as diseased tonsils, sinuses, teeth or in the gastro-intestinal tract. This conception of stricture postulates that in the majority of cases ureteral infiltration is primary, and that the other urinary tract lesions so often associated with stricture, such as stone in the ureter, hydronephrosis, pyelitis and pyonephrosis, are secondary. In substantiation of this assumption, Hunner has had a few cases which have persistently showed no material improvement in symptoms until after the removal of infected tonsils or teeth, and another list of patients who have been dismissed as well after dilatation of the strictures or after getting rid of the pyelitis by dilatation of the stricture and lavage, and who have returned with

⁹³ Illinois Medical Journal, 1918, xxxiii, 20.

⁹⁴ Bulletin of Johns Hopkins Hospital, 1918, xxix, 1.

their old symptoms after a fresh tonsillitis attack or after undergoing dental work.

Regarding the symptoms that are presented by these cases of ureteral stricture, it may be stated that pain is the most common, and only in rare cases is it absent. To attempt to draw a pain chart of this affection one would need a diagram of the human frame extending from the diaphragm to the ankles. The most deeply shaded portion of this chart would center in the local area of ureteral inflammation, or, in other words, in the broad ligament region deep in the pelvis. From this center of inflammatory discomfort in the pelvis the pain may radiate in any direction, upward toward the kidney, laterally into the hips or groin region, posteriorly, simulating a sacro-iliac joint condition or a sciatica, and downward into the thigh and leg either posteriorly or anteriorly. Next in frequency to the local ureteral pain is pain in the kidney region. This is probably at times a referred pain from the inflammatory area in the ureter, but it is usually due to overdistention of the pelvis of the kidney. The urine may be quite negative on repeated careful centrifuging and microscopic search. Chills and fever are common in cases with urinary infection. A patient with infection may go for weeks or months without chills or appreciable fever, and, indeed, may be in apparently perfect health, or may suffer only from malaise and general depression.

The stricture is located in the broad ligament region or within 6 cm. of the bladder in by far the greater number of cases. The next most frequent location is at the bifurcation of the internal iliac vessels or about 8 to 10 cm. above the bladder, which is from 3 to 5 cm. below the pelvic brim. In both of these regions there are groups of lymphatic glands, and at operation these are sometimes found enlarged. The inflammatory area itself varies from a slight annular thickening to one which may occupy several centimeters of the ureter and form a mass 1 centimeter in diameter, while multiple annular strictures are not uncommon.

One of the most interesting side-lights on ureteral disease furnished by this study has been the revelation of the probable cause of most ureteral stones. In operating for a ureteral stone and finding it encased in dense infiltration tissue, we have heretofore considered the inflammatory area as due to the irritation of the stone. At present, however, there is abundant evidence to indicate that the stone results from urinary salts being deposited on the inflamed surface of the stricture area.

The *diagnosis* of ureteral stricture depends upon the history, urinary examination, palpation of the abdomen, with special reference to the kidney, and ureter regions, palpation of the ureters through the vagina or rectum, cystoscopy, catheterization of the ureters by specially prepared catheters, and roentgenography. Cystoscopy is usually quite negative, but in the occasional case in which the stricture is near the bladder wall there may be redness and edema about the ureteral orifice, suggesting the picture seen with a low ureteral stone. One of the most suggestive points in cystoscopy is the finding of a urethral stricture when preparing the urethra for the cystoscope. Although stricture of the

female urethra is common after a gonorrheal infection, Hunner has learned by experience to give its presence considerable weight in the diagnosis of a suspected ureteral stricture. The crucial test, however, in diagnosing ureteral stricture is made with the wax-bulbed catheter.

The chief end sought in the *treatment* of this condition is the relief of symptoms, and in the infection cases a urine freed from infection. In all cases suitable for dilatation such a thorough opening of the stricture area should be made that there will be no recurrence. There are very few cases in which the symptoms cannot be ameliorated, and fortunately, in the majority of cases, the patients can be relieved to a large extent if not entirely. There are very few cases of pyelitis in which the infection cannot be controlled, but Hunner believes that time will demonstrate that in many cases it will be impossible to get a permanent dilatation of the stricture and complete relief of symptoms until the original focus of infection has been eradicated. When all the methods of vesical approach fail we have to consider operative measures. No form of operation should be undertaken until as complete investigation as possible has been made of both sides. Stricture of the ureter being bilateral in 30 per cent. of the cases, we cannot afford to take anything for granted in dealing with a case in which symptoms may be confined to one side.

Renal Tuberculosis. Bugbee⁹⁵ states that the present status of renal tuberculosis may be summarized by stating that it may be a primary lesion, and it arises from a filtration of tubercle bacilli from the blood stream into the parenchyma or tubules of the kidney, where changes similar to those found in tuberculous foci in other parts of the body take place. An effort is always made to wall off the process, but the formation of antibodies is so slow and the immunity of the patient, which may have always been absent or which may have been temporarily diminished, is so low that the lesion usually gets beyond control, and usually goes on to wide destruction of the kidney and extension to the other kidney, to other parts of the urinary tract and of the body. From the nature of the lesion, remissions are common and the symptoms of renal tuberculosis are misleading, often slight at the onset, giving no indication of the extent of the lesion.

The diagnosis of this condition may be simple, or, on the other hand, the most difficult of all urinary lesions, often requiring preliminary treatment to allay acute symptoms and repeated cystoscopical examinations over a long period of time.

The treatment cannot be outlined from a study of the symptoms, but it is most important that the remission of symptoms, often for long periods of time, should not be accepted as a cure. The effort on the part of nature to inhibit the progress of the disease and to limit the lesion should be borne in mind, utilized and encouraged in every possible manner in inoperable cases as well as before and after operation. Occasionally the lesion may become arrested and walled-off, but even when arrested a kidney the site of poorly drained cavities is a menace to the system, therefore, nephrectomy for unilateral renal tuberculosis is the proper treatment.

⁹⁵ Surgery, Gynecology and Obstetrics, 1918, xxvi, 479.

Iodide Solutions in Roentgenography. The use of thorium solutions, as opaque media in pyelography, has practically superseded the old colloidal silver solutions on account of the greater safety, but one objectionable feature against thorium is the amount of care necessary in making a satisfactory solution. A more common and inexpensive substance whose aqueous solution is neutral would be preferable. For this purpose, Cameron⁹⁶ suggests a 50 per cent. solution of potassium iodide, which is almost completely opaque to the roentgen rays. The solution is perfectly clear and is strongly saline in taste, but not irritating to the tongue. It has a low viscosity, can be readily sterilized by boiling and is miscible with urine and blood without causing any precipitation or coagulation. The important question as to the possibility of these solutions causing toxic effects or local irritation is being thoroughly investigated. Though from the nature of these substances no such effects are anticipated, it cannot be stated now that they are entirely innocuous. However, Cameron has used solutions of high concentration in the kidney pelvis of the lower animals and has used a 15 per cent. solution in the human bladder, and no undesirable effects of any nature have been encountered. Excellent roentgenograms were obtained in all instances.

⁹⁶ Journal of the American Medical Association, 1918, lxx, 754.

DISORDERS OF NUTRITION AND METABOLISM; DISEASES OF THE GLANDS OF INTERNAL SECRETION; DISEASES OF THE BLOOD AND SPLEEN.

By ELMER H. FUNK, M.D.

DISORDERS OF NUTRITION AND METABOLISM.

Nutrition. Never before in the history of medicine and allied sciences have the various problems connected with foods received such widespread and intensive study. Food production, supply and distribution; food equivalents and costs; the basic requirements of civil and military life, etc., have all been discussed with the view to conservation—a conservation made necessary by the abnormal demands incident to the state of war. A National Food Administration has successfully coped with the problem at home. An Interallied Food Commission, consisting of representatives of the various national food administrations, practically controlled the dietary supplies of 220,000,000 people outside the central powers. The Interallied Commission¹ established as the minimal food requirement of the individual “for a man weighing 154 pounds, doing average work during eight hours a day, the food as purchased should have an energy value of 3300 calories per day, but that a reduction of 10 per cent. could be supported for some time without injury to health.”

Graham Lusk² has charted, so to speak, our information, both authentic and as nearly accurate as our present knowledge permits, of the fundamental requirements of energy for proper nutrition in four classes of subjects: (1) boys from birth to sixteen years of age; (2) soldiers at hard work; (3) men in industrial pursuits; (4) women in industrial pursuits. The accompanying charts speak more than volumes of words, and are herewith reproduced (Figs. 67 to 70).

Lusk points out again what Allen and Du Bois showed in 1916, namely, that the basal requirement of energy in men may be largely reduced through reduction in weight of the individual. Anderson and Lusk shortly afterward demonstrated in animals that when a given amount of work is to be done, it is always accomplished at the expense of exactly the same amount of extra calories no matter what the nutritive condition of the animal may be; it is the same in the thirteenth day of starvation as when the dog is fully nourished. It is evident, therefore, that one may reduce the basal requirement of energy by lessened weight, such as occurs when the individual is “trained down hard”—without detriment to the health and efficiency.

¹ Science, July 19, 1918, p. 60.

² Journal of the American Medical Association, 1918, lxx, 882.

It is interesting to note that the food allowance of our army has been most liberal. It appears from recent official statistics³ that our troops have the most liberal allowance of food among all the Allies' rations. The United States garrison ration calls for 4600 calories; indeed, in

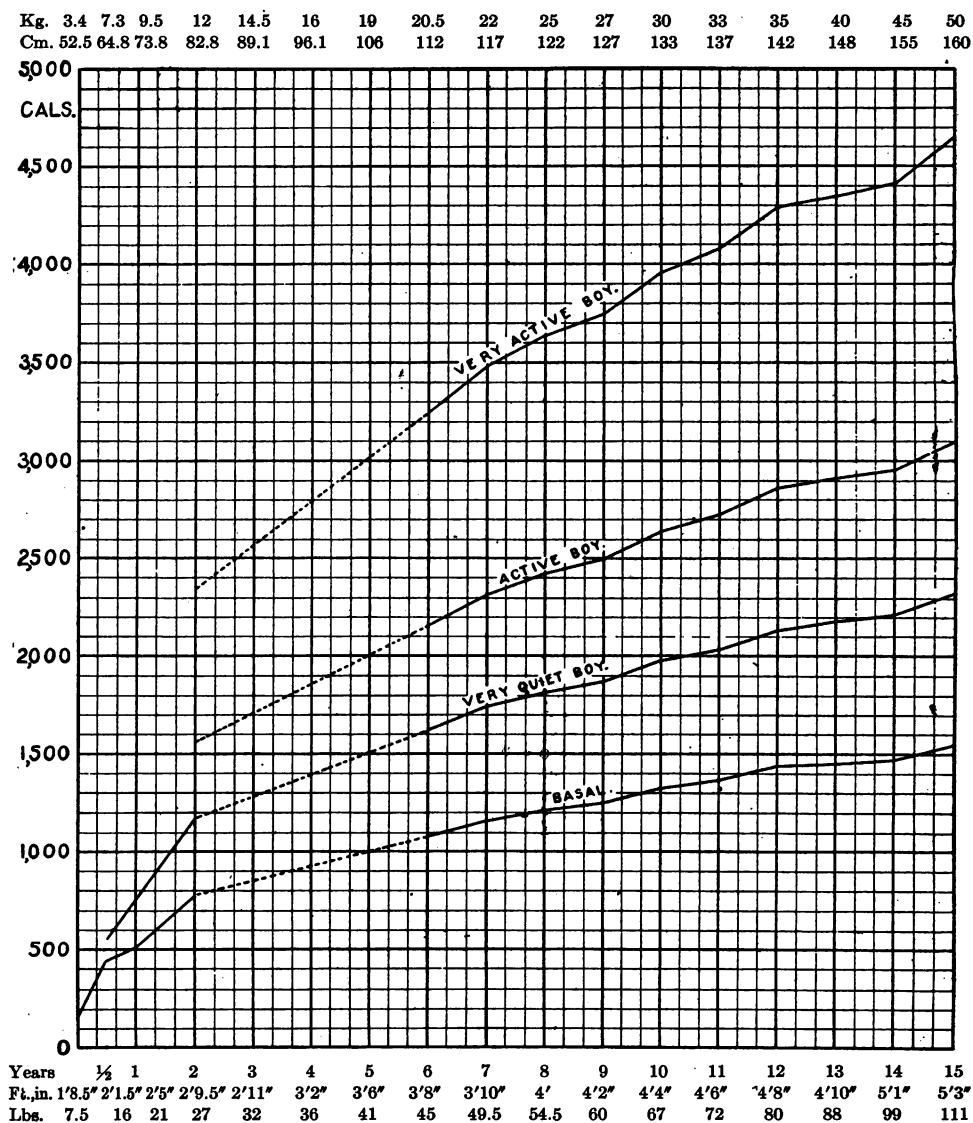


FIG. 67.—Metabolism in calories per day of boys from birth to fifteen years of age.

so-called modified garrison ration, 4800 calories are provided. The maximum food allowance of the British, Canadian, French and Italian troops does not exceed 4200 calories, the estimated value of the British

³ Editorial, Journal of the American Medical Association, 1918, lxx, 1864.

field and trench ration. The food surveys made by the Food Division of the United States Sanitary Corps from eighty-seven messes showed a consumption of 4000 calories a day, thus distributed between the groups of nutrients: proteins, 14 per cent.; fats, 30 per cent.; carbohydrates, 56 per cent. On this diet, supplemented by a certain consumption of

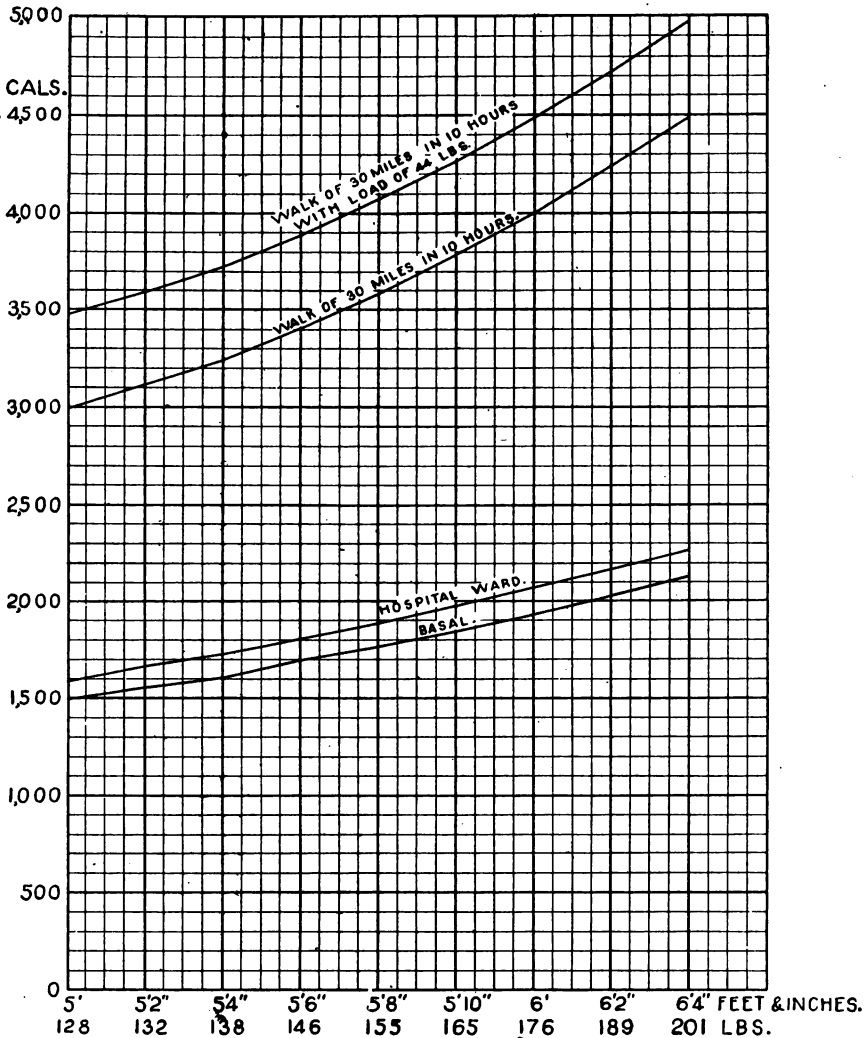


FIG. 68.—Metabolism in calories per day of a soldier making a forced march of thirty miles at the rate of three miles per hour.

food from the camp exchanges, the men, according to Murlin, have gained in weight, on an average, about 9 pounds since entering the training camp.

Another phase of the food problem which has engaged investigators is the conservation of food energy at its source, namely, at the farm.

H. P. Armsby,⁴ expert in Animal Nutrition of the United States Department of Agriculture, has summarized many of these observations in a recent book. To quote Armsby—however bountiful the farmers' crops,

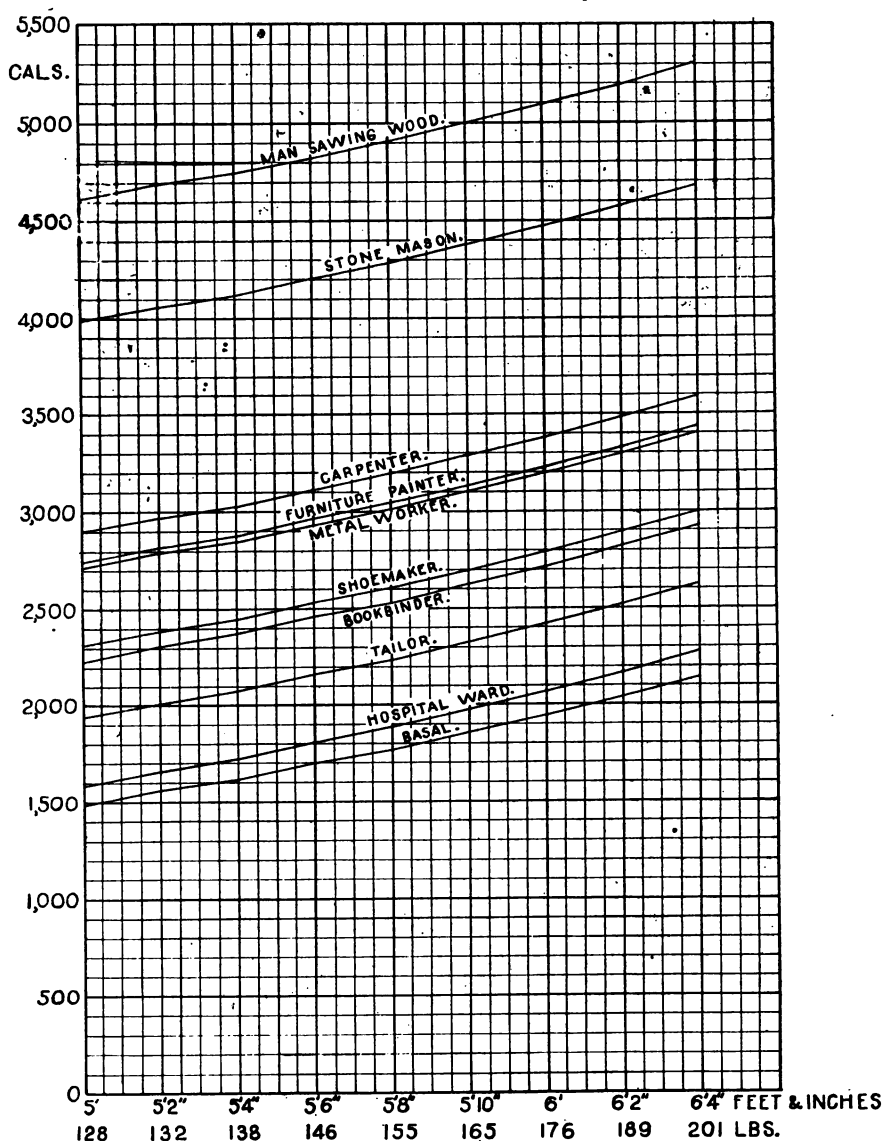


FIG. 69.—Metabolism in calories per day of men engaged for eight hours in various industrial pursuits.

in their crude state they are not human food. Some of them, like hay or the straw of his grain crops, can be utilized only indirectly by feeding

⁴ The Conservation of Food Energy, Philadelphia, 1918.

them to live stock. Others, like wheat and corn, while they can also be used as animal foods, are commonly thought of as being directly available to man. This, however, is only partially true. While meat may be fed to live stock, man does not eat wheat but wheat flour, and wheat yields only approximately about two-thirds of white flour along with one-third of milling offals useful only as stock feed.

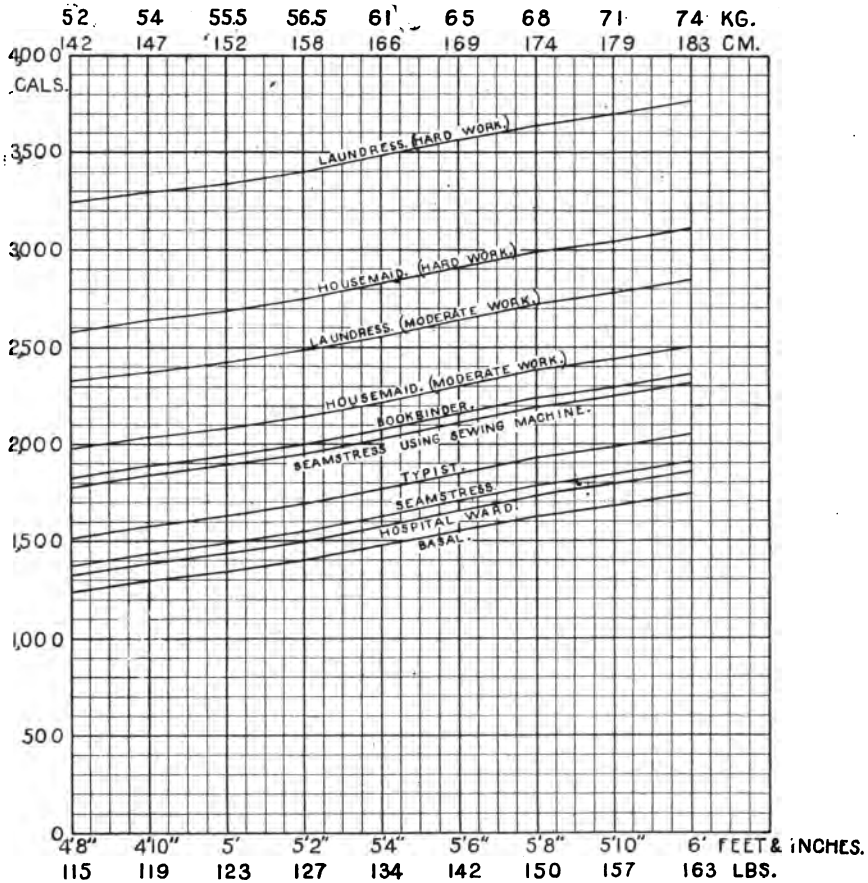


FIG. 70.—Metabolism in calories per day of women engaged for eight hours in various industrial pursuits.

Two alternatives, then, are open for the conversion of farm crops into human food: (1) they may be fed directly to animals to produce beef, mutton, pork or milk; (2) such of them as admit of it may be subjected to various manufacturing processes—milling, starch and glucose manufacture, oil extraction, brewing, distilling—by which a greater or less proportion of them is converted into forms acceptable for man's use and the by-products of these operations may be utilized in the production of meat or milk.

The problem tersely stated is this—How can one obtain the greatest

human food value out of a bushel of wheat or corn? Shall it be fed to live stock, and if so, the beef steer, the mutton sheep, the hog or the dairy cow; or shall it be manufactured into flour or table meal or used as a source of starch, glucose or alcoholic beverages and only the residues of these processes be fed to live stock? Armsby summarizes the problem by comparing the proportion of total energy of the products which can be recovered for man's use when fed directly to live stock, and when milled and the offals fed.

	Average percentage recovery of energy.			
	With cattle and sheep.		With pigs and dairy cows.	
	Fed directly.	Milled and offals fed.	Fed directly.	Milled and offals fed.
Wheat	23	70	57	77
Corn	22	{ 81 70	58	{ 85 82
Barley	23	61	55	73
Rye	24	64	61	75
Oats	16	58	40	64
Rice	19	57	50	62
Buckwheat	15	56	36	60

The obvious point of these studies is that there is a great loss of energy involved in the conversion of edible vegetable into animal products; that is, in feeding live stock, *i. e.*, only 14 to 61 per cent. is recovered for man's use. Again, as Armsby states, the recovery of energy in animal products differs widely with the nature of the animals fed. In this respect, cattle and sheep form one distinct group and pigs and dairy cows another, differences within each group being relatively small. In the production of beef and mutton the loss is very large, ranging from 75 to 86 per cent. This is due in part to the extensive fermentation which occurs in the stomach of cattle and sheep and in part to the relatively large proportion of inedible material contained in their bodies. In milk and pork production, the losses are notably smaller, ranging from 39 to 66 per cent. The body of the pig contains much less inedible matter than that of the steer or the sheep and his feed is subject to less fermentation than in ruminants. The conversion appears to be decidedly more efficient in milk production than in meat production while there is no inedible waste. On the other hand, as Armsby points out, the animal performs a most important function in the utilization of products inedible by man. The various forage crops and the inedible by-products of manufacturing through the medium of the animal can be made tributary to man's support. It is true that there may be an even greater loss in the conversion than obtains with the grains, but whatever is thus recovered is so much added to the food supply and the importance of utilizing these materials to the greatest practicable extent can hardly be overemphasized.

The brewing and distilling industries, on the contrary, show a very low utilization of the energy of their raw materials unless the full theo-

retical food value is assigned to the alcohol produced. Only some 28 to 35 per cent. is recovered in other products in brewing and only from 4 to 16 per cent. in distilling. Even if the alcohol be included in the computation, the recovery is still notably lower than that obtained by milling the same materials, as appears from the following tabulation:

	Percentage recovery of energy.			
	Offals fed to cattle or sheep.		Offals fed to pigs or dairy cows.	
	Including alcohol.	Excluding alcohol.	Including alcohol.	Excluding alcohol.
In brewing barley	53	28	60	35
In distilling:				
Corn	62	6	72	16
Rye	56	4	62	11

CHEESE. In view of these facts the wisdom of meat economy as directed by the Food Administration and of beverage economy is evident. Among the products suggested to take the place of the protein of meat is cheese, which represents in addition an advantageous way in which milk can be stored for future use. The cheese consumption per year in 1909 was about three or four pounds per person, an amount which might with advantage be considerably increased. In an editorial⁵ discussion of this subject it is pointed out that one obstacle to the wider dietary employment of cheese in the United States is the fact that many types of this food have been traditionally imported and there exists a mistaken belief that the home varieties are not as good. With the increase of our knowledge with regard to cheese bacteriology it becomes evident that the quality of cheese is not so much a question of countries or climes as of microorganisms and science. As an example, one finds Evans⁶ demonstrating that the microorganisms essential for the manufacture and ripening of Roquefort cheese are *Streptococcus lacticus* and *Penicillium roqueforti*. *Streptococcus lacticus* decomposes the lactose during the manufacture of the cheese, and thus produces the lactic acid necessary for the cheese-making. These organisms disappear from the cheese after two or three weeks, being killed by the high concentration of sodium chloride. The remaining flora of Roquefort cheese consists of cheese streptococci and *Bacterium bulgaricum*, organisms that are found in all kinds of ripening cheese. All experimental cheeses of this variety were made from cows' milk, but there was no evidence of any essential variation from the imported product. A wider use of cheese, in its various forms, may be expected with our own production of it and the increasing knowledge of its value as a food.

NUTS in a way are comparable to cheese, in that they have a high food value. They contain proteins and fats, except chestnuts, which are poor in fats but rich in carbohydrates. The use of nuts heretofore has been

⁵ Journal of the American Medical Association, 1918, lxx, 1764.

⁶ Journal of Agriculture Research, 1918, xxiii, 225.

considered as an accessory to the diet, an accessory which possesses a certain indigestibility. Actual experiment has demonstrated, however, that the charge of inherent indigestibility is not borne out⁷ provided the nuts are consumed under proper conditions. The reported distress attending their use is probably due to inadequate mastication, so that larger masses of an impervious vegetable product are ingested, or they are eaten after an already abundant meal. Morgan and Heinz⁸ have studied the biological values of almond and wheat proteins, with the result that the protein of almond meal was found to have a value superior to wheat gluten. These observations with that of Hoobler,⁹ who last year adduced experimental evidence of the high value of nut proteins in relation to human milk proteins, tend to increase our respect for nuts as foods. Certainly the plant proteins, such as cereals, nuts, legumes and other green vegetables, are not as inferior to the proteins of animal origin, meat, eggs and milk, as our previous popular misconception led us to believe. Nuts have a concentrated food value; twelve to fifteen almonds, for example, are approximately equal to one hundred calories, and properly masticated they may be used to replace or augment the proteins.

NUTRITION IN CHILDHOOD. Another phase of the nutrition problem involves childhood, and here we are confronted with Manny's¹⁰ observation that at least one-third of the school children of New York are so much below normal standards of growth as to call for special nutritional care; and of this group at least one-third required medical treatment. Not so long ago C. J. Thomas, in 1916, estimated a similar state of affairs in 10 to 15 per cent. of the English school population. The solution lies in the proper education of the public, especially the poorer classes, as to what constitutes an adequate diet consistent with the income of the family; this instruction should be supplemented by competent school medical inspection by experienced physicians. The adequate feeding of the poor continues to be a problem. There was less actual poverty during the past year than within recent years, and yet one finds many instances of undernutrition which, more often than we think, are due to the lack of knowledge of comparative food values of objects purchased.

The Food Deficiency Diseases. VITAMINES. A most important discussion of the diseases due to deficiencies in nutrition occurred at the last meeting of the American Medical Association in Chicago, June, 1918, when a symposium on this topic included papers by E. V. McCollum, A. F. Hess, J. Goldberger, G. A. Wheeler and E. Sydenstricker, J. R. Murlin and P. Roth.

McCollum pointed out that the studies of the past decade have revealed the fact that the adequate diet of the higher animals must contain protein of the type known as "complete," by which we mean a protein yielding all the amino-acids that are required in nutrition. It must contain, in the form of suitable salts, at least nine of the inorganic

⁷ Editorials in *Journal of the American Medical Association*, 1918, lxxi, 467 and 974.

⁸ *Journal of Biological Chemistry*, 1919, xxxvii, 215.

⁹ *American Journal of Diseases of Children*, 1917, xiv, 105.

¹⁰ *Survey*, March 20, 1918.

elements, namely, calcium, magnesium, sodium, potassium, iron, chlorin, iodine, phosphorus and sulphur. The sulphur must be in organic combination in the form of the amino-acid cystine. The diet must supply a suitable quota of energy in the form of protein, carbohydrates and fats, and must, in addition, contain certain substances of unknown chemical nature, which we know as "vitamins."

It is recalled that McCollum, and his co-workers, previously pointed out that there are two of these chemically unidentified substances called fat-soluble "A" and water-soluble "B." The first of these is found abundantly in certain fats, as those of the egg yolk and milk; the second is never associated with any fats of either animal or vegetable origin. When the diet lacks the substance of fat-soluble "A," animals develop a peculiar eye affection in which the tissues surrounding the orbit swell until the eyes cannot be opened. There is inflammation of the cornea, and blindness results within three or four weeks. The eyes resume the normal appearance after a period of feeding such foodstuffs as contain the dietary essential in question. What is termed water-soluble "B" is the "curative" substance for polyneuritis, or beriberi.

McCollum and his co-workers consider these two syndromes as the only deficiency diseases in the strict sense of the term as applied by Funk. Scurvy and pellagra, while due to faulty diet, are apt to be explained in other ways than by a specific complex in the diet.

Scurvy. ETIOLOGY. We are confronted with two groups of studies: one upon animals and the other upon human subjects. The experimental work of McCollum and Pitz, discussed in last year's issue of *PROGRESSIVE MEDICINE*, in which they contend that the protective or curative value of antiscorbutic foods is dependent upon their laxative properties and interchangeable with laxatives, such as liquid petrolatum or phenolphthalein, is controverted by the clinical experience of A. F. Hess,¹¹ who, in an observation of many cases of infantile scurvy, has become convinced that constipation plays no essential role in this disease. Hess emphasizes his previous and present observations that the potato, which is a sovereign remedy for scurvy, is not a laxative, and malt-soup preparations, which most readily lead to this disorder, are rather laxative than constipating. To this evidence may be added the clinical experience that infantile scurvy does not yield to treatment by liquid petrolatum, but that its symptoms are rapidly alleviated by small additions of orange juice to the dietary, so small as to be without apparent effect on the bowels. In this connection is added an observation that orange juice, boiled and rendered slightly alkaline, may be given intravenously with signal success; this procedure leads to no laxative action, and it is evident that its effect cannot be explained in this way.

It would seem from the rather contradictory findings of experimental scurvy and human scurvy that we may be dealing, as Gerstenberger¹² suggests, with a pseudo-scurvy or rickets in the guinea-pig and not the scurvy we conceive of as occurring in human beings. In any event, we must not forget that in all animal experimentation the greatest care

¹¹ *Journal of the American Medical Association*, 1918, lxxi, 94.

¹² *American Journal of the Medical Sciences*, 1918, clv, 253.

must be exerted not to fall into the error of translating experimental results in animals directly into terms of human disease. This may explain the divergent results obtained in animal and human scurvy.

Antiscorbutic substances are required in the diet of every individual. The antiscorbutic minimum is unknown, but Hess¹³ states that the margin of safety over our annual supply is certainly not very great, assuredly not as large as the excess of water-soluble vitamin, which is so abundantly distributed throughout Nature, and probably no greater than that of the fat-soluble vitamin, which McCollum has shown to be present to a considerable extent in milk, eggs and the leaves of plants. How scant the margin of safety is in some countries may be judged from the fact that in Ireland they are dependent for their health in this regard on the potato—when the crop fails, scurvy develops.

Hess states that undoubtedly scurvy has increased recently in both civil and military population of the warring countries. He quotes a number of references—some of which were reviewed in this section of *PROGRESSIVE MEDICINE* last year.

INFANTILE SCURVY. Comby¹⁴ calls attention again to the fact that every infant given a sterilized food, either milk or a proprietary food, for several months, without any fresh or living food, is menaced with scurvy. In the 55 cases he has encountered, in over 45 an erroneous diagnosis had been made, and the children had been given sodium salicylate for the assumed rheumatism, or they had been treated with electricity and massage for the supposed acute poliomyelitis, or given mercurial treatment for assumed syphilis, or incisions and trephining had been done for supposed acute osteomyelitis. Some had been put in a plaster cast or trough for coxalgia or Pott's disease. In the last few months he has encountered 13 new cases, and in 90 per cent. the attending physician had failed to recognize the scurvy. One infant recently had been treated for six weeks for rheumatism and then for acute poliomyelitis, no one heeding the one-sided diet. Comby ordered the child to be left quiet in its cradle, not bathing or dressing it, nor moving it abruptly in any way. A teaspoonful of grape juice was given twice a day, and fresh milk, boiled, was given instead of condensed milk. In eight days recovery was complete. The children with scurvy are generally between six and eighteen months old, and the painful pseudo-paralysis of the legs is a prominent symptom.

The antiscorbutic factor of lemon juice has been studied by Harden and Zilva,¹⁵ who found that after the removal of the free citric and other acids the residue retains antiscorbutic activity. Experiments in animals show that under certain precautions as to temperature the preparation can be concentrated in bulk to any desired volume or even evaporated down almost to dryness without losing the antiscorbutic potency. The application of a concentrated preparation is of considerable value clinically, as heretofore the rapidity of relief and cure has depended upon the quantity of certain foods of recognized antiscorbutic value

¹³ *Journal of the American Medical Association*, 1918, lxxi, 94.

¹⁴ *Presse Médicale*, Paris, 1918, xxvi, 480.

¹⁵ *Biochemical Journal*, 1918, xii, 259.

which could be administered, and this quantity has necessarily been determined chiefly by the toleration of the patient. In the case of infants this imposes considerable limitation, for the articles chiefly used are orange juice, grape juice and powdered potato beaten up with milk. Digestive disturbance, particularly diarrhea, is apt to occur unless these are used with caution. The antiscorbutic potency of such foods cannot, therefore, be utilized to its full extent.

Harden, Zilva and Still¹⁶ used the concentrated preparation in the treatment of 4 cases with extremely rapid amelioration of the symptoms. They stress the statement that it is possible by this method, for example, to give quantities of the antiscorbutic factor, equivalent, *e. g.*, to the juice of six to twelve lemons daily, an amount which, given in the form of potato or fruit juice, would set up severe gastro-intestinal disturbances.

The shortage of certain foods recognized as satisfactory antiscorbutics and the expensiveness of orange juice for the less well-to-do classes have stimulated the investigation of the antiscorbutic value of various foods. Recently, according to Gibbons and McClugage¹⁷ and Hess and Unger,¹⁸ the tomato has been found to rank as an efficient antiscorbutic. The latter observers have actually administered canned tomatoes to infants who were receiving pasteurized milk, substituting it in the dietary for orange juice, which has become increasingly expensive. The amount given to babies three months or more of age was 15 c.c., half this quantity being given daily to younger infants. The tomatoes have been uniformly well tolerated throughout the summer by babies as young as one or two months of age. The fact that both groups of investigators found that the methods of preservation—canning and drying, respectively—do not entirely deprive the tomato of antiscorbutic potency gives a welcomed addition to the list of foods available the year around, affording protection to adults and children on otherwise restricted diets.

Pellagra. ETIOLOGY. Year by year since 1914 Goldberger and his associates have accumulated data which point with increasing clearness to the controlling influence of diet in both the prevention and causation of this disease. The most recent one by Goldberger, Wheeler and Sydenstricker¹⁹ is a comparative study of the diets of non-pellagrous and pellagrous households in textile mill communities in South Carolina. Pellagra incidence was determined by a systematic bi-weekly house-to-house search for cases, carried on from April to December. The diagnosis of pellagra was restricted to cases presenting a definite, bilaterally symmetrical eruption. Data relating to household diet were secured by obtaining records of sale from the principal stores for a fifteen-day period during the season immediately anterior to, or coincident with, the incidence of the attack as suggested by the seasonal curve, supplemented by inquiries by a trained investigator. Comparisons of diets of non-pellagrous with those of pellagrous households clearly showed that:

¹⁶ Lancet, 1919, cxvii, 17.

¹⁷ Proceedings of the Society of Experimental Biology and Medicine, 1918, xvi, 2.

¹⁸ Ibid., 1918, xvi, 1.

¹⁹ Journal of the American Medical Association, 1918, lxxi, 944.

1. The non-pellagrous enjoyed a larger supply of the animal protein foods (lean meat, milk, including butter, cheese and eggs).

2. Varying supplies of fresh meat were associated with a corresponding (inverse) variation in the incidence of pellagra.

3. Varying supplies of milk were associated with a corresponding (inverse) variation in the incidence of pellagra.

4. The caloric value of the diets of pellagrous households was somewhat less than that of non-pellagrous households, but this, nevertheless, conformed to recognized standards and could therefore not be considered as an essential factor in relation to the incidence of pellagra.

5. The total protein supply in the diets of the pellagrous households was less than in that of non-pellagrous households, but was not below Chittenden's standard, and therefore a deficiency in total protein would seem not to be an essential factor in relation to the incidence of pellagra.

6. The proportion of protein from animal food tends to be somewhat smaller, and that from cereals and the common mature peas and beans somewhat larger in the diets of the pellagrous than in those of the non-pellagrous households, and therefore the protein in the diet of the non-pellagrous was likely to be of somewhat better quality than that in the diets of the pellagrous households.

7. The diets of the pellagrous households included somewhat less of the carbohydrates than did that of the non-pellagrous, and therefore the production of pellagra is not necessarily dependent on an excessive consumption of this food constituent.

8. The diets of the pellagrous households had a decidedly smaller supply of the fat-soluble and likewise a somewhat smaller supply of the water-soluble vitamin than the diets of the non-pellagrous households.

9. The mineral constituent of the diets of the non-pellagrous households was likely to be superior—less likely to be defective—than that of the pellagrous households.

This study by Goldberger, Wheeler and Sydenstricker would seem very clearly to suggest:

First. That the pellagra-producing dietary fault is the result of one or more of the following factors: (1) a physiologically defective protein supply; (2) a low or inadequate supply of fat-soluble vitamin; (3) a low or inadequate supply of water-soluble vitamin and (4) a defective mineral supply. In this connection it is of interest to note that McCollum, Simmonds and Parsons,²⁰ as a result of their studies of faulty diets in rats, believe that pellagra is primarily associated with the unsatisfactory character of three dietary factors, namely, a shortage of the fat-soluble "A," the faulty character of the inorganic moiety and the relatively poor quality of the protein mixture.

Second. The somewhat lower plane of supply, both of energy and of protein, of the pellagrous households, though apparently not an essential factor, may, nevertheless, be contributory by favoring the occurrence of a deficiency in intake of some one or more of the essential dietary factors, particularly with diets having only a narrow margin of safety.

²⁰ Journal of Biological Chemistry, 1918, xxxiii, 411-423.

Third. The pellagra-producing dietary fault may be corrected and the disease prevented by including in the diet an adequate supply of the animal protein foods (particularly milk, including butter and lean meat).

With regard to the infections *versus* the non-infections, or dietary origin of pellagra, it is interesting to note that Vaughan and Welch,²¹ appointed by Surgeon Rupert Blue, of the Public Health Service, became convinced, after careful study of all the publications of Goldberger and his associates and his opponents, and after a thorough study on the ground, that pellagra is a disease of malnutrition. A visit to the Insane Asylum at Milledgeville, Ga., housing 4000 patients, revealed the following: Two years ago and more Goldberger took charge of one colored and one white ward in this asylum. Cases of pellagra were in all the wards. Goldberger changed only the diet; in addition to the ordinary food furnished the inmates, he supplied additional animal food. Pellagra has wholly disappeared from the wards under Goldberger's care, and has persisted in all other wards. When the experiment was begun, these two wards contained a large number of pellagrins, all of whom have recovered, and in none of whom has there been seasonal reappearance of the disease. From time to time patients have been added to these wards, and within a few weeks have recovered completely, so far as pellagra is concerned; while in all other wards the disease has persisted. Here were two wards in a large asylum with the inmates of all wards living under exactly the same conditions with the exception of diet. In the two wards placed on a liberal diet pellagra disappeared, while in other wards it has persisted. Vaughan states that this was one of the most striking and successful experiments that he has ever seen, or, so far as he knows, has ever been recorded.

The exact food constituents, the presence of which, or absence of which, produce pellagra, have not been determined. H. Gideon Wells²² had an unusual opportunity to observe one of the largest mass experiments on human deficiency disease of recent times in Roumania which suffered from starvation during the war as almost no other country. The deficiency diseases were particularly to be seen and observed, and the conditions were particularly good for studying them, because he had an opportunity to contrast two sets of people, differing not at all in geographical situation or in opportunities for caring for themselves, but who differed in their habits of diet—that is, the Russians and Roumanians. The deficiency diseases among these two sets of people were quite different, and their dietary habits were different. As one went down the Russian and Roumanian fronts and saw where pellagra occurred and where it did not occur, the thing that stood out, in a way that one could not get away from, was that where there was pellagra the chief article of diet was always yellow corn; and where one has corn he has pellagra. There were starvation and scurvy among the Russians, but the Russians' fundamental dietary article was black rye bread and beans.

²¹ Journal of the American Medical Association, 1918, lxxi, 954.

²² Ibid.

Before the war pellagra was common in Roumania. The writer was told that there were from 60,000 to 80,000 cases before this time. Pellagra occurred only in the districts of Roumania where this limited diet was prevalent. It occurs in direct proportion to the extent that the people cannot supplement "mamaliga," or corn-meal mush diet, with other foods.

Last summer, after having been in the war about a year, the Roumanians were beginning to observe just what the Austrians on the other side of the line observed after they had been in the war for a year; and that was a form of edema which, at first, they thought was an acute nephritis, with dropsy—face, feet and hands swollen—but no renal changes. This disease is described in Germany as the "Kriegsoedem," or war dropsy. This was beginning to appear in Roumania among the people who had been most seriously deprived of food. It is noticed in the usual dietary of the Roumanians an evident deficiency in fats. They cannot afford to eat the butter that they make, and while they use the cows and oxen for transportation purposes, they do not seem to get very much milk from them. Wells found, so far as he had time to observe it, that when these patients were given butter fats they were likely to get better. But, of course, when under treatment they always got milk, soup and other things. Another thing about pellagra that was quite striking to Wells was that before the war, in Roumania, as in most countries, pellagra occurred chiefly in adults, presumably because it takes a great many years of dietary deficiency of ordinary degree to produce it; but in those districts of Roumania in which the war had reduced the diet almost solely to corn-meal mush, they find a very acute form of pellagra in children five or six years of age. So the thing that stood out all the time in our observation was: Yellow corn and pellagra.

Volpino,²³ who has been studying pellagra for years, reports his experiences among pellagrins and non-pellagrins injected with extracts of spoiled and sound maize. The response to such an injection when positive is characterized by a pronounced local and general reaction. His observations, combined with those of others, revealed the following: Among 146 pellagrins there were 136 positive and 11 dubious reactions; while among 130 non-pellagrins there were only 33 positive responses.

Beriberi. Beriberi is perhaps the best example of avitaminosis. It came into prominence when the rice grain subjected to modern milling lost its embryo and a considerable part of the pericarp. The polished rice, so-called, deprived of certain substances essential to nutrition, produced the disease because of the lack of an indispensable component present in the "polishings." Chick and Hume²⁴ have demonstrated that the more important location of the antiberiberi vitamin is in the embryo or germ and not the pericarp of the grain. This rather widely accepted etiology of beriberi is considered inadequate by Walshe²⁵ on the basis that it conflicts with the results obtained in starvation experiments on

²³ Amali d'Igiene, Rome, 1918, xxviii, 280, abstracted in Journal of the American Medical Association, September 28, 1918.

²⁴ Proceedings of the Royal Society, B., 1917, xc, 44.

²⁵ Quarterly Journal of Medicine, 1918, xlv, 11.

fowls. Starved fowls live sufficiently long to develop the disease under such conditions, yet they die without developing it, although in this essential respect, namely, the deprivation of vitamins, starvation is the equivalent of an avitaminic diet. Walshe points out that all recent experimental work, both in man and poultry, reveals two factors in the production of beriberi: (1) The absence of an accessory food factor or vitamin; (2) the use of certain foods which are the direct and immediate cause of the disease. There is a considerable weight of evidence to prove that carbohydrates constitute this second direct and immediate factor. It seems probable that in the absence of their specific vitamin they undergo an aberrant hydrolysis with the production of toxic by-products, or end-products, thus producing beriberi. Viewed in this light the disease is an intoxication. Walshe questions whether the clinical and pathological characters of the disease are compatible with the theory that it is a slowly progressive, diffuse degeneration of the nervous system. The striking symptoms of beriberi and the widespread visceral and nervous changes seen postmortem cannot be accounted for by such an hypothesis. Finally, it seems certain that until the physical chemistry of the vitamins and the metabolism in beriberi—both totally unexplored fields—have been more fully investigated, the pathogenesis of beriberi will remain in part obscure. All the genesis of the disease may be best expressed, according to Walshe, by saying that the use of certain food-stuffs, probably carbohydrates, in the absence of their accessory food factors or vitamins, directly causes beriberi.

On the other hand, Vedder²⁶ has pointed out that the antineuritic vitamin is not concerned in carbohydrate metabolism; and in prescribing a diet to prevent beriberi it is sufficient to ensure the consumption of such quantities of antineuritic foods—beans, rice polishings, barley, etc.—as experience has indicated will prevent the disease, without any reference to variations in the amount of carbohydrate consumed.

CLINICAL MANIFESTATIONS OF BERIBERI. The clinical manifestations of 60 cases of beriberi have been recorded by Riddell, Smith and Igara-videz,²⁷ who report their observations from the base hospital at San Juan, Porto Rico. This is the first time, so far as the authors can determine, that the disease has been recognized as such in the island of Porto Rico.

The symptoms began in almost every case with a numbness over the legs, usually over the shins first and gradually spreading over the calves and upward to the knees, over the thighs and then to the abdomen, between the umbilicus and symphysis pubis. In some cases it also affected the upper extremities, usually the finger-tips, and extended upward to the hands, forearms and, in a few cases, to the arms.

Pain was noticed in every case in the calf muscles, and in nearly every case was first noticed in this area. The peroneal group was next in order of frequency and time to be affected. Of the thigh muscles the quadriceps were first and also more severely affected, with the hamstring group next and abductor group last. Intense pain was caused by

²⁶ Journal of Hygiene, 1918, xvii, 1.

²⁷ Journal of the American Medical Association, 1919, lxxii, 569.

pressure on these affected muscle groups. There did not seem to be any greater degree of tenderness over the course of the large nerve trunks.

Only about one-third of the patients had any pain in the hands, and the tenderness on pressure was not marked, the thenar eminences being most tender. The flexor muscles in the forearms were the most tender in that area.

Edema was noticed to a small degree in 34 cases. This was localized in the ankles and over the tibias, but disappeared after a few days in bed. Two patients had general edema, though not very marked on admission, but this also disappeared after a few days in bed. The urine in these cases was negative to albumin.

Areas of partial anesthesia, in some cases being only a blunted sensibility, were found in over half of the cases. The part most affected was the shins, other parts of the leg together being but slightly more affected than the shins alone. The feet, abdomen and thighs were affected in the order named, with a few areas in the hands and forearms. Hyperesthesia was found in 9 cases.

Absence of fever was very noticeable; only 11 patients had some slight fever at the onset, which lasted but a few days. Gastric disturbance was still less frequent, only 7 cases of nausea, or nausea and vomiting, being recorded, and this at the onset for but a few days. Complete anorexia was reported as beginning symptoms in 4 cases, and this was improved either when the patient had been admitted or after a few days in the hospital.

Some form of cardiac affection was found in only 12 cases, consisting in tachycardia, enlarged heart or a murmur. Whether these were complications of the disease or existed previous to the disease cannot now be told.

The patellar reflex was absent in 26, diminished in 26 and the Romberg phenomenon was present in 46 cases. Incoördination could be determined in these cases by other means.

Korsakoff's syndrome was absent in every case.

Thirty-three of the patients reported that they had not had influenza in the present epidemic. Seventeen did have, and 6 had that disease in the epidemic four months before.

Two patients were admitted with attacks of acute dyspnea. Both had general edema, with rapidly progressing edema of the lungs. The heart action was rapid and very feeble, and was enlarged downward and to the right and left. Their feet and hands were cold and gradual increasing cyanosis was present from the time they entered the hospital. Acute distress was most marked and nothing could give relief. The patients gasped for breath, were intensely restless and at times were wild with agony. Death occurred in both cases before twenty-four hours in the hospital had elapsed.

All patients began to improve when placed on a high protein diet, and practically no medication was given. The surgical management of the cases consisted in relieving all tension on muscles showing even a slight trace of paralysis. Six patients when received showed a marked degree of equinovalgus. The affected muscles in these cases were put

at rest by the application of a light plaster cast extending well out to the toes, holding the foot at right angles to the leg; the cast was removed as soon as the foot-drop symptoms disappeared. All but one patient on a highly nitrogenous diet promptly regained normal function of muscles involved. Thirty-two patients still remain in the hospital under treatment.

Experimental Polyneuritis and the Nature of the Dietary Essential Water-soluble "B." The exact nature of water-soluble "B" is not known, and considerable interest has been aroused in the various attempted methods of isolation and identification of this substance. McCollum and Simmonds²⁸ state that, so far, the results have been so meager that an entirely different plan of procedure from that heretofore attempted must be employed. They have reviewed the previous attempts and applied the following experimental method to young rats. When these animals are placed upon a diet which is satisfactory in every respect except for the absence of either of the dietary factors, fat-soluble "A" or water-soluble "B," a considerable gain in weight may take place during the first three weeks. After the second or third week, there is no further increase in weight and either a brief period of maintenance is followed by rapid decline, or steady loss of weight begins, and death follows after a variable period, unless the missing dietary essential is supplied. When the diet is lacking in the water-soluble "B," but is properly constituted in other respects, typical polyneuritis results in many of the experimental animals. Histological studies show that there is a degeneration of the motor cells of the cord in animals restricted to such a diet.

Animals given a diet which is properly constituted, except that it is lacking in the fat-soluble "A," may increase in weight during the first two weeks, then they gradually lose weight, become emaciated, and suffer from edema of the eyelids. This condition has recently been described as xerophthalmia, and it is believed to be due to this specific dietary deficiency. There is no loss of motor function in these animals. Their eyes are very much irritated and they scratch them and thereby cause mechanical injury. Recovery is prompt when the missing dietary factor is supplied, otherwise permanent blindness ensues and death supervenes, usually within three months.

Since there are no chemical methods for the detection of these two unidentified dietary essentials, McCollum and Simmonds employed biological tests as a guide to their isolation. In conducting their observations, McCollum and Simmonds followed the plan of feeding a diet of purified food substances together with 5 per cent. of butter fat to supply an abundance of the fat-soluble "A." This diet was complete except that it was free from the water-soluble "B." The rats were confined to this food mixture until they either had become stationary in weight or were declining. By the fifth week nearly all were either stationary in weight or were failing, and they almost invariably showed signs of paralysis at about this time. When the rats were thus prepared, the

²⁸ Journal of Biological Chemistry, 1918, xxxiii, 55.

material to be tested for the water-soluble "B" was put into the diet. The animals then either continued to decline or responded with growth. This method served to show within two weeks whether the substance "B" in significant amount was in the preparation under investigation. Without going further into detail as to the method, it is sufficient to say that McCollum and Simmonds, in their experiments, found that the water-soluble "B" is not extracted directly from beans, wheat germ or pig kidney by ether, benzene or acetone, but is readily extracted in great part by alcohol. After being removed by alcohol it is shown to be soluble in benzene, but very slightly soluble in acetone. The probability that there should be two or more physiologically indispensable substances in what we term water-soluble "B," both or all of which should show the same solubility relations with these three solvents, is relatively small and lends support to our view that the substance which protects animals against polyneuritis is the only essential complex in the extracts described. In other words, the data support the view that there are no specific substances present in these extracts which protect against such diseases as scurvy, rickets, pellagra, sprue, etc., and tend to confirm our contention that the latter are not due to specific starvation, as is the case with beriberi and xerophthalmia.

Diabetes. ETIOLOGICAL FACTORS. *Syphilis.* The part which syphilis plays in the etiology of diabetes has been carefully considered since Warthin and Wilson, in 1916, called attention to the frequency of syphilitic lesions at autopsy in diabetics. Williams,²⁹ in a study of the problem, dissents from the previously expressed views of Warthin and Wilson especially, that a negative history and Wassermann test are inconclusive evidence of the absence of syphilis in diabetes. Williams states that many combined clinical and pathological studies reported in the literature support the belief that the Wassermann reaction is a dependable procedure in 70 to 90 per cent. of all types of syphilis. Among his 143 cases of diabetes only 4 cases had a positive reaction. In the hands of other clinicians of wide experience in diabetes only from 3 to 10 per cent. react positively. Furthermore, the physical examination of 126 cases for lesions characterizing syphilis does not lend support to the view that the disease is a common causal factor in the production of diabetes. Thus in 124 cases a routine examination of the following reflexes was made: pupils as to equality and reaction to light, patellar reflex, Romberg's sign, coördination, tremor and gait. In 80 cases there were no disturbances of any character in the reflexes. In 36 cases there was a disturbance in the quality of either the patellar or the pupillary reflex. Not one case of Argyll-Robertson pupil or positive Romberg sign was discovered, nor did a single case exhibit ataxia or lack of coördination, and there was only one case showing noteworthy tremor. In this series, evidences of syphilis of the central nervous system are lacking.

In 122 cases the patients were carefully examined for enlarged glands. In 38 cases the cervical glands were distinctly palpable; but, aside from

²⁹ Journal of the American Medical Association, 1918, lxx, 365.

an occasional involvement of a single gland in other parts of the body, it may be said that there was absolutely no evidence of adenitis. Of the 38 patients exhibiting enlargement of the cervical nodes, 33 had obvious and serious mouth infection involving either the teeth, the tonsils, or both. Cultures of many of the nodes were made, and various strains of streptococci were isolated. It is highly improbable, therefore, that syphilis is the common factor affecting these glands.

In 126 cases careful notes were made as to the condition of the peripheral arteries. In 34 cases there was an obvious sclerosis, while in the other 92 no change was detected. The cause of arterial degeneration in diabetes is not as yet understood. Syphilis may be a factor in its production. It is not unlikely that other infections and intoxications may initiate it. Of the 34 patients in this series exhibiting abnormal sclerosis, one had acromegaly with high blood-pressure, another had a poisonous thyroid, a third had tuberculosis of long standing and 26 others had severe mouth infection. In the absence of all other evidence of syphilis, and in the presence of known infection which may induce sclerotic changes in bloodvessels, the arteriosclerosis in this series can scarcely be advanced as proof of syphilitic involvement.

Finally, the practice of Williams's clinic of making routine examinations of blood cholesterol adds biochemical evidence of the absence of syphilitic infection. Cholesterol determinations were made in 89 diabetics giving negative Wassermann reactions. In 37 a cholesteremia existed. The influence of lipoidal substances in the complement-fixation test is well understood by serologists; cholesterol is purposely added to reinforce or make more sensitive the Wassermann test. A negative test among these patients is, therefore, a stronger evidence of the absence of syphilitic infection than under ordinary conditions.

Williamson³⁰ investigated the etiology of 300 cases of diabetes with the following result: Prolonged excessive use of sugar, sweet foods or sweet drinks (alone or combined with other predisposing causes) in 93, or 31 per cent.; prolonged and intense mental anxiety, worry, overstrain or sudden mental shock (alone or combined with other predisposing causes) in 120, or 40 per cent.; family history of diabetes (alone or combined with other predisposing causes) in 76, or 25 per cent.; no definite predisposing cause in 59, or 19 per cent. Williamson believes that the recent food restriction will tend to diminish the risk of diabetes. There are many others who believe that the increased consumption of sugar, particularly in the form of candy, during recent years, is one of the explanations of the increased frequency of diabetes. The average consumption of sugar per individual between 1800 and 1810 was about eleven pounds a year; in 1910 to 1917 about 73 pounds. It is certain that in those who have a family history of diabetes the excessive use of sugar should be interdicted.

CERTAIN CHEMICAL CONSIDERATIONS IN DIABETES. *Terminology.* The term glycosuria is a relic of the days when the copper tests were insufficient to demonstrate the small quantity of sugar normally present

³⁰ British Medical Journal, 1918, i, 139.

in the urine. Glycosuria, as pointed out by Benedict, Osterberg and Neuworth,³¹ implies a sudden point at which sugar appears in the urine—a point which does not exist, and therefore is misleading. The term glycuressis is proposed for the increase, rather than the new appearance of sugar in the urine.

Blood-sugar. At the Johns Hopkins Hospital, Mosenthal, Clausen and Hiller³² have pointed out certain interesting facts with regard to the effect of diet on the blood-sugar in diabetes mellitus. Superimposed doses of glucose are not necessarily followed by a step-like rise in the blood-sugar. The blood-sugar remains at the fasting level or below it throughout the day in those cases in which the initial hyperglycemia is marked (for example, from 0.17 to 0.45 per cent.); whereas it rises in those in which it is low (from 0.12 to 0.16 per cent.). It seems, according to the writers, that each diabetic has a blood-sugar level at which his carbohydrate metabolism proceeds in a fairly normal manner, with no rise in blood-sugar after meals of a moderate starch content. In very mild cases, this acquired blood-sugar level may be very low and no increase result after the eating of a starch-free meal; whereas, in individuals with a very marked derangement in their carbohydrate metabolism, such a favorable blood-sugar level will be proportionately increased. When this optimal glucose percentage in the blood is reduced by dietary restrictions, the organism tends to respond on the least provocation by a hyperglycemia. It is under such circumstances that there occurs an increase in the glucose of the blood after ingestion of protein and fat. The occurrence of mild hyperglycemia during muscular exercise would seem to support the contention that the organism tends to use glucose more effectively when the blood-sugar is at a higher level. In an editorial discussion³³ of the possible significance of the high sugar content in diabetes, one finds this rather terse comment: "Can it be that the rise in blood-sugar content in diabetics represents an attempt of the organism to adjust carbohydrate metabolism for the more advantageous utilization of sugar, as seems to happen after exercise? If so, there may be some wisdom in the suggestion of Mosenthal and his associates that we must not counteract the effective use of glucose when the blood-sugar is at a higher level. Translated into clinical dietotherapy, it may be desirable not to attempt to reduce the blood-sugar to a normal value in every case of diabetes. One sometimes hears a somewhat analogous argument in discussion of fever when the relation of the higher temperature to the febrile process is under debate."

One of the puzzling problems of blood-sugar is the occurrence at times of hyperglycemia without glycosuria. One hypothesis advanced is that the increased sugar, like the normal blood-sugar, is in colloidal combination in contradistinction to "free sugar" occurring in pathological conditions. The argument advanced against this view is that the glucose in the blood is readily dialyzable. Kleiner,³⁴ however, points

³¹ Journal of Biological Chemistry, 1918, xxxiv, 258.

³² Archives of Internal Medicine, 1918, xxi, 93.

³³ Journal of the American Medical Association, 1918, lxx, 541.

³⁴ Journal of Biological Chemistry, 1918, xxxiv, 471.

out that the evidence has always been obtained with the blood of normal animals. Kleiner has compared the diffusibility of sugar in the blood from diabetic animals and normal animals—the latter sugar values raised to the same height by the addition of glucose. The results would indicate that there is evidence for the existence of combined sugar in diabetic blood: The diabetic blood-sugar dialyzed at an irregular rate with periods of delayed or interrupted dialysis; the normal blood with added free sugar was not interrupted in this manner. This may explain further the failure to store or utilize carbohydrate in diabetes—the less easily diffusible sugar cannot pass through the capillary walls into the tissues.

DIABETES COMPLICATING PULMONARY TUBERCULOSIS. Although diabetes and tuberculosis have been known since the earliest times, the study of the association of the two diseases is of comparatively recent interest. The occurrence of tuberculosis in diabetes, according to Landis, Funk and Montgomery,³⁵ is not more frequent in diabetics than in the general population at the same age periods. Out of 111 cases of diabetes collected in the hospitals of Philadelphia, 9 had active pulmonary tuberculosis and 1 other had adrenal tuberculosis. Out of 51 non-fatal cases of diabetes, none had active pulmonary tuberculosis. Out of 51 non-fatal cases of diabetes, none had active pulmonary tuberculosis. Out of 60 fatal cases of diabetes, 9 had active pulmonary tuberculosis, and 1 other had adrenal tuberculosis. Out of 35 fatal but non-autopsied cases of diabetes, 3 had active pulmonary tuberculosis. Out of 25 postmortems, 6 showed active pulmonary tuberculosis and 1 tuberculosis of the adrenal gland without tuberculosis elsewhere. Out of 86 non-autopsied cases (35 fatal), 3 had active pulmonary tuberculosis and 17 more had signs recorded that were only slightly suggestive of tuberculosis. Out of 355 autopsies collected from the literature since 1882, including Montgomery's 25 cases, 138 (38.9 per cent.) revealed pulmonary tuberculosis mostly in the acute form.

The occurrence of diabetes and glycosuria in tuberculosis is comparatively infrequent. Among 31,834 cases of tuberculosis collected from 25 tuberculosis sanatoria and hospitals in various parts of the United States, there were 101 (about $\frac{1}{3}$ of 1 per cent.) cases of glycosuria and 51 (about $\frac{1}{6}$ per cent.) cases of diabetes. Some of the cases classed as glycosurics were undoubtedly diabetics, so that the percentage of diabetics may be assumed to be between $\frac{1}{3}$ to $\frac{1}{6}$ of 1 per cent. of all these tuberculous cases. Autopsy statistics vary somewhat as in the following table:

	Pulmonary tuberculosis.	Diabetes mellitus.
Reports of the Surgeon-General, Public Health and Marine Service, 1895 to 1905	373	0
Henry Phipps Institute until end of 1910	479	1
Jefferson Hospital, Tuberculosis Department	110	1
Adami and McCrae: Pulmonary Tuberculosis, with Cavity Formation	85	4
	<hr/> 1047	<hr/> 6

³⁵ American Review of Tuberculosis, vol. ii, 690.

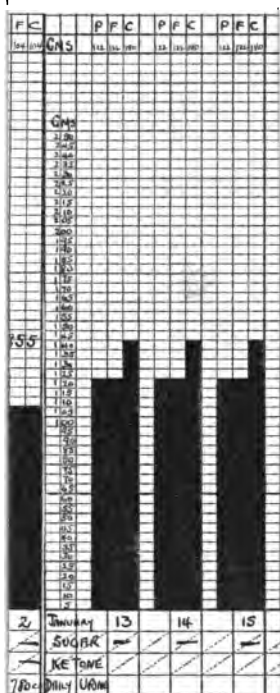
Treatment of Diabetes Mellitus Complicated by Tuberculosis. The combination of diabetes and tuberculosis in the past was sufficient to render an almost hopeless prognosis. The problem presenting itself was that of one disease requiring dietetic restrictions and the other requiring an abundant diet. The treatment was unsatisfactory because, in most instances, the tuberculosis was considered paramount and the diabetes less important. We now know that it is vitally important to control the diabetes first of all, at the same time instituting other measures for the tuberculosis, such as rest, etc., as are compatible with the diabetic treatment. Among the 12 cases studied by Landis, Funk and Montgomery, 10 were males and 2 females. Their ages were from twenty-eight to sixty-nine years. One case was incipient, 5 were moderately advanced, and 6 were far advanced. One revealed questionable activity, 3 slight activity, 2 moderate activity, and 6 considerable or marked activity. The prognosis in 6 cases was doubtful, and in 6 cases unfavorable. In 7 of the 12 cases, fasting was practised at the start, in 2 for five successive days, in 4 for three successive days, and in 1 for two days before the urine became sugar-free. In all of the cases except one, fast days were ordered at various times during the course of the treatment.

In 5, of the 12 cases, the urine could be rendered sugar-free on a standard carbohydrate-free diet plus various additions to this diet, including a moderate amount of carbohydrates. These were evidently patients with some carbohydrate tolerance. One patient, however, could be kept sugar-free only by ultimately resorting to fasting. Nine of the patients exhibited amelioration in symptoms, and the improvement was noted as follows:

1. Weight (+10½ pounds), strength, cough, expectoration, fever.
2. Weight (+11½ pounds), strength, cough, expectoration, fever.
3. Weight (+ 3½ pounds), strength, cough, expectoration, fever.
4. Weight (+ 1 pound), strength, cough, expectoration, fever.
5. "Felt better."
6. Weight (+ 8 pounds), strength, cough, expectoration, fever.
7. Weight (+ 5 pounds), strength, cough, expectoration, fever.
8. Weight (+15 pounds), strength, cough, expectoration, fever.
9. Weight (+10 pounds), strength, cough, expectoration, fever.

The Physical Signs in 5 of the 9 cases just mentioned did not change while the patients were under observation. In 1, rales which were not noted on admission became audible at one base. In 3, the number of rales at the apices were considerably reduced. Three of the 12 patients showed progressive tuberculosis, 2 finally dying. There is no evidence of any causative relation between the dietary restriction and the unfavorable course of these 3 cases.

As these results indicate, it is possible for patients with tuberculosis and diabetes to partake of a considerably restricted diet over a period of some weeks and still show an increase in weight and strength, a fall in temperature, and a lessening of respiratory symptoms. Whether these results in their cases would have been still more favorable on a more generous diet, or whether the progressive cases owe their failing health in a measure to the dietary limitations, cannot be stated. Nor

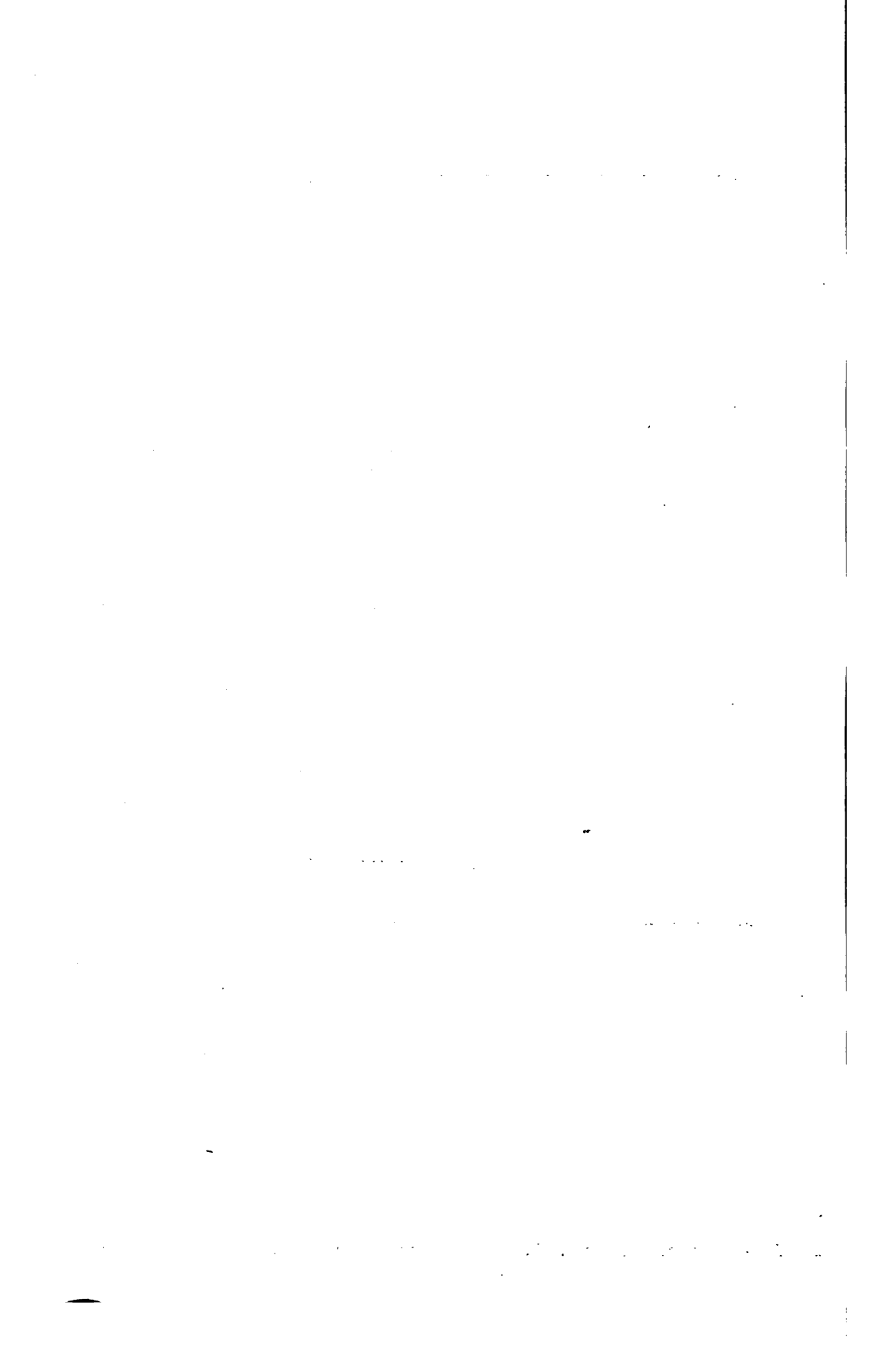


WEN SANATORIUM
WEN HAVEN, PA.
WEN CHART

Admitted 12-5-1916



FIG. 71. THE VALUE OF THE DIET FOR THE TREATMENT OF HEMORRHAGES AS DEPICTED



has it been determined whether the reduction in the amount of sugar in these cases has had any effect on the pulmonary process. Other conditions being equal, we feel that prompt treatment of the diabetes, according to the method of Allen, offers the tuberculosis patient the best chance in the ultimate effort to control the tuberculosis. This is well illustrated by reference to one of the following case histories reported by the writers:

A. M., male, aged forty-one years, admitted to the White Haven Sanatorium, December 5, 1916.

Family History. Mother died at sixty-nine years of age of diabetic gangrene.

Personal History. Fifteen years ago had hemorrhages from the lungs, for which he was sent to Colorado, where after a short time he gained in weight and became free from symptoms. Since that time he has had numerous attacks of blood-spitting, and some years ago was told by a doctor that he had sugar in the urine. Within the past two months he developed a frequent, productive cough, pronounced weakness, chilliness and fever, and loss of weight from 190 to 160 pounds. Upon admission, he was quite sick, chilly and spitting blood.

Physical Examination. There were signs referable to the upper right lung. There were abundant crackling rales at the right apex and a few at the left apex. The sputum showed tubercle bacilli. The urine on four successive days varied in its specific gravity from 1035 to 1040, and showed sugar in amounts from 3.4 to 4.6 per cent., and a faint reaction for diacetic acid.

Treatment. The patient was placed at rest in bed in the open and on the regular house diet to determine the degree of glycosuria. He was then fasted for two days before he became sugar-free, when he was given 200 gm. of 5 per cent. greens. Subsequently the diet was increased as per the attached chart. During the administration of the treatment, hemorrhages occurred and continued almost daily in varying amounts up to 9 ounces, until, after a period of approximately two weeks, it was deemed imperative to induce pneumothorax, when a sudden cessation followed. The subsequent course of the tuberculosis and diabetes was favorable, as is well shown in the attached weight, temperature, and other charts. Shortly before discharge, which was demanded because he felt so well, the patient indulged in several dietetic indiscretions, with a consequent derangement again of the sugar tolerance. They feel confident that in this particular case if the patient had remained under treatment sufficiently long and with acquiescence to the dietetic restrictions, he could subsequently have reached a point where, with a fairly liberal diet, he would have made further gains in weight, remained sugar-free, and continued to arrest more and more the tuberculous lesion. It was most interesting to observe the results of treatment in this patient which was instituted in the presence of recurring pulmonary hemorrhages that ultimately required therapeutic pneumothorax.

THE TREATMENT OF DIABETES MELLITUS. The practitioner who desires to obtain a simple and yet adequate presentation of the subject in a practical way will do well to consult one of the year's new works, a

small book by E. P. Joslin, entitled, *A Diabetic Manual for the Mutual Use of Doctor and Patient*. The opening paragraph of Chapter II, Part II, contains this terse comparison of normal and diabetic diets: "Four-sevenths of the calories of the diet in health are made up of carbohydrate, two-sevenths of fat, and one-seventh protein; but in diabetes the diet is composed almost exclusively of the latter two foods. This is not discouraging, for until recently the Eskimo's diet contained only about one-seventh carbohydrate. It takes time and experience to learn to live successfully upon a diabetic diet, and it is only with time that the body adjusts itself to a diet with so marked a reduction of carbohydrate and so marked an increase in fat. It is indeed wonderful that it is possible for the body to do so at all." The reviewer cannot resist mentioning in passing that this valuable little book should be on every physician's library shelf.

The problem which confronts the physician in treating a diabetic according to the modern restrictive régime is how little food can be given without detriment to the physical and mental condition of the patient. Mosenthal and Clausen³⁶ have studied the maintenance diet in diabetes as determined by the nitrogen equilibrium, which represents the lowest possible diet standard which can be exacted of any patient, if that patient is to be maintained in reasonably good condition for any considerable period. A nitrogen equilibrium under these circumstances results in the conservation of the protein tissues, but does not necessarily prevent the loss of fat. How far the fat store of any individual may be depleted with advantage is another question. There is much to be said in favor of allowing the diabetic to become thin, so that his metabolism may be established at a lower level, as has frequently been urged; but it would be distinctly appreciated that this loss of weight should occur in the fats and not in the vitally necessary proteins.

According to them, furthermore, diabetic patients may be established in nitrogen equilibrium by a carbohydrate-free diet having a caloric value equal to the standard total caloric requirement. A rough estimate of what constitutes a maintenance ration for the diabetic on a carbohydrate-free diet is placed by Mosenthal and Clausen at between 1500 and 2000 calories, with the reminder that women and small persons generally require less food than men and larger persons.

In a study of the comparative food value of protein, fat and alcohol in diabetes mellitus, as measured by the nitrogen equilibrium, Mosenthal states that they endeavored to ascertain if the protein tissue could be maintained on a carbohydrate-free diet. A patient was put on 1000 calories with a constant proportion of protein and fat. Then 500 calories of protein, fat or alcohol were added. Three periods were used—fat period, alcohol period, protein period. Finally, there was a control period. On 1000 calorie diet there was a constant loss of nitrogen. With an additional 500 calories of fat, there was no great improvement in the nitrogen balance. The fat was assimilated, but did not spare the protein. The same held true with alcohol. The alcohol possibly saved the body

³⁶ Archives of Internal Medicine, February, 1918, p. 269.

fat, but not the nitrogen. The results with protein addition were strikingly different. The positive nitrogen balance was very marked indeed with 1500 calories. Two patients who did not take the alcohol did not get the results. The fat and alcohol had been used to conserve the fat of the body, while the protein preserved the protein even on the protein and fat diet.

THE DURATION OF LIFE. The duration of life of diabetics is discussed in an unusually interesting paper by Horner and Joslin³⁷ in which a study of 62 cases of fifteen or more years' duration is reported. The reviewer knows no follow-up system among diabetic patients which has been so thoroughly carried out as by Joslin and his co-workers in Boston. In this latest study by Horner and Joslin of a series of 1187 cases, one finds these very interesting conclusions: Of the 1156 traced, 640 are living and 516 are dead; among these were 62 who lived fifteen or more years, or 5 per cent., and, of these, 37 are living and 25 are dead. Obesity, which is universal in the long-lived diabetic, was demonstrated in 60 cases out of 62. A diabetic heredity is one and one-half times as frequent among the cases of fifteen or more years' duration as among all the diabetic patients. The average loss of weight when the patient first came to the authors for treatment was 41 pounds. Gall-stones were recognized in 8 cases, being six times as frequent among these cases as in the entire series of 1187 cases. The presence of acidosis was demonstrated twenty-one times and in 11, or 44 per cent., of the fatal cases the patients succumbed to it. By the avoidance of acidosis the lives of these patients might have been prolonged. Arteriosclerosis occurred in 36 cases, and was a prominent factor in causing the death of 10 patients. Diabetes is now a minor issue in 50 per cent. of the living patients and at the time of death was a minor issue in 28 per cent. of those who had died. An extremely rigid diet is necessary for only 4 of the patients now living. Of the fatal cases, 20 per cent. outlived the normal expectation of life for their age at the onset of their diabetes, and this is true for 10 per cent. of the living cases. Dietetic treatment was carried out to a considerable degree by 57 patients. Of the remaining 5 patients, 3 are among the dead.

Renal Glycosuria. The term renal diabetes is a misnomer, and the condition should be called renal glycosuria, or perhaps more properly, renal glycuressis. True instances of renal glycosuria are very rare and many of the reputed cases are probably atypical cases of ordinary diabetes. There is no failure on the part of the tissues to utilize carbohydrates, no hyperglycemia, and the lesion probably renal rather than pancreatic. There is lowered kidney threshold for carbohydrates. Klemperer, who first noted this condition in 1896, found it associated with the evidences of a mild nephritis; others since have noted it in the absence of nephritis. Klemperer further stipulated that the glycosuria should be within wide limits independent of the amount of carbohydrate in the food and that the sugar in the blood should not at least be increased, but rather diminished. The ordinary symptoms of diabetes

³⁷ American Journal of the Medical Sciences, 1918, clv, 47.

are usually absent and the glycosuria not infrequently discovered by accident.

Beard and Grave³⁸ report a case of renal glycosuria which, on admission, was thought to be one of atypical diabetes and the usual routine treatment was given in preparation for starvation, namely, the fats were first eliminated from the diet. After four days' starvation, glycosuria was still present and the blood-sugar remained at the same level as on admission. A low caloric diet was next administered and starvation was later repeated. The glycosuria still persisted and the blood remained unchanged to any great extent. On account of this fact, the dextrose-nitrogen ratio was determined. After a constant diet of protein and fat for six days, the glycosuria disappeared. The next few days, on starvation, glycosuria was absent, this being the only time during the stay in the hospital that the patient was sugar-free. It was thought the case might correspond to the usual diabetic treatment, but on a diet containing 7 gm. of carbohydrate the sugar output was 7 gm. The blood-sugar still remained fairly constant.

In renal glycosuria there is probably a lowered kidney threshold for carbohydrates. Our modern investigation of the blood-sugar shows, according to Langstroth,³⁹ that in normal persons it reaches its lowest point after a night's fast and rises soon after taking carbohydrate food into the stomach. From a half to one hour after the introduction of 100 grams of glucose into the fasting stomach the blood-sugar rises from the normal level of 0.08 per cent. to 0.11 per cent. to not over 0.15 per cent., and falls within one and a half to two hours to below 0.11 per cent. In diabetes the beginning of the blood-sugar curve is frequently much above 0.11 per cent., while in milder and less understood types of carbohydrate disturbance it may lie within or below the normal limits. When the blood-sugar rises to a point between 0.17 per cent. and 0.18 per cent., even in the normal individual, glucose is excreted in the urine, and this point is spoken of as the kidney threshold for glucose. Renal glycosuria represents a lowering of this threshold while the blood-sugar response to a carbohydrate meal is normal. Langstroth's patient is interesting in that there were not only evidences of renal glycosuria, but of altered carbohydrate metabolism as well. The patient presented no symptoms of diabetes. The daily amount of sugar excreted by this patient varied from a trace to 14 grams, but bore no relation to the amount of carbohydrate ingested except during the fast days, when only traces were found in the urine. A night's fast sufficed to make the urine sugar-free at 8 A.M. the following day. The blood-sugar was below normal at this time, but after 100 grams of glucose increased to above the normal expected rise and did not return to normal until the fourth hour. The percentage of glucose in the urine varied from 0.22 per cent. to 1.5 per cent., and was inversely proportional to the amount of urine. Kidney function was normal so far as could be determined by the phenolsulphonephthalein excretion and the blood-urea nitrogen.

Langstroth states further that independence of the glucose excreted

³⁸ Archives of Internal Medicine, 1918, xxi, 705.

³⁹ American Journal of the Medical Sciences, 1919, clvii, 202.

from the carbohydrate in the diet is not consistent with true diabetes, as Allen has shown, and it was felt from this patient's response to increased carbohydrate intake on fixed amounts of protein and fat that the glycosuria would prove to be entirely dependent on a low kidney threshold. Although the kidney threshold was determined between points too far apart to be of value (0.05 per cent. and 0.17 per cent.), it may be supposed that it was quite low, because during the two fast days when the blood-sugar would perhaps not be expected to rise very much above the fasting level (0.05 per cent.), traces of sugar were still excreted. This lowered threshold would satisfactorily explain the presence of the small amounts of glucose constantly found in this patient's urine. But when 100 grams of glucose were given after a night's fast, the blood-sugar curve was found to show a higher rise than the normal expected one and a delayed fall. This type of curve has been found associated with mild diabetes and with ductless gland disease, and apparently demonstrated some abnormality of carbohydrate metabolism. We may suppose that this individual would have excreted a small amount of glucose only when the curve reached its highest point if the kidney threshold had not been low, so that the blood-sugar response was not concerned with the glycosuria.

Bailey⁴⁰ believes that two types of cases can be recognized: (1) Cases with normal or subnormal blood-sugar and glycosuria, which is greatly influenced by blood-sugar changes; (2) cases with a constant glycosuria which varies with the rate of urinary excretion and is little influenced by blood-sugar changes. He reports two cases in detail in illustration of these types. The first patient is one of constant glycosuria without hyperglycemia. Alimentary hyperglycemia, while the patient was pregnant, was slightly delayed and prolonged, this being probably due to decreased functional activity of the bowels and kidneys. Alimentary hyperglycemia in the non-pregnant state was of the normal type, the curve reaching its highest point in about one hour, returning to the original value in two and a half hours, falling to a low point in three hours, then increasing and maintaining its level in three and a half to four hours' time. Alimentary glycosuria was excessive. It varied directly with the glycemia and was present to a marked degree even in the presence of a hypoglycemia, the permeable point of the kidneys being below a blood-sugar concentration of 0.086 per cent. (the normal kidneys being permeable between 0.16 and 0.17 per cent.). The patient's history points strongly to this being a congenital condition. Since the accidental discovery of sugar in her urine in 1908, her condition has remained unchanged, although her diet has never been restricted. Her daily output of sugar is about 20 grams.

The second case reported gave the subjective and objective symptoms of chronic parenchymatous nephritis. Nothing in the patient's history or in the physical finding would lead one to suspect a disorder of carbohydrate metabolism. He had a constant hyperglycemia, but no higher than is ordinarily found in chronic nephritis. The blood-sugar curve

⁴⁰ American Journal of the Medical Sciences, 1919, clvii, 221.

following the ingestion of glucose was of the type found in non-diabetic nephritis. Of special interest is the fact that glucose constantly appeared in his urine and that the rate of excretion was greatest when the blood-sugar concentration was low. A hyperglycemia was accompanied by a decreased excretion of sugar.

Jarlov and Kraunsoe⁴¹ report in detail several cases of renal glycosuria in one family. One young man had the glycosuria for seventeen years. It did not seem to be modified by restriction of carbohydrates, but when the diet was of an antidiabetic nature, acetone appeared in the urine. This acetone content was still more marked in this young man's cousin, who had been treated for severe diabetes in boyhood and returned ten years later for treatment. Closer analysis of the case, however, disclosed none of the characteristics of diabetes to correspond to his high glycosuria. Under three months of hospital treatment he gained 1200 gm. in weight but the sugar-content of the urine was still 1.8 per cent. when dismissed and there were traces of acetone. He returned a year later with 5 per cent. sugar, and again this was reduced under treatment, but with the appearance of diacetic acid and acetone, and sugar-content of 1.6 per cent. by the end of the month. At nineteen the percentage was 3.3, and this was reduced by antidiabetic diet to 0.5, but diacetic acid and acetone then were constant. The blood-sugar content was continuously normal, and the patient's general health was constantly good. Acidosis was never observed when the patient was on an ordinary diet, but it developed under antidiabetic dietary restrictions every time, and disappeared anew as soon as the ordinary diet was resumed. The young man's immediate family showed no tendency to glycosuria, but his cousin was the first case mentioned above, and this young man's brother has 1 per cent. sugar in the urine with normal blood-sugar percentage. Similar cases described by others are analyzed by Jarlov and Kraunsoe in connection with these cases. They all teach that attempts to banish the sugar from the urine by antidiabetic diet are not only unnecessary and futile, but that they are directly harmful, bringing on acidosis, during which the patients feel sick, while they are subjectively in the best of health on an ordinary diet.

Acidosis. The wise use of the simplified methods of identifying acidosis has led to the recognition of its presence in many conditions other than diabetes. Most of the literature which has appeared during the past year deals with acidosis in conditions other than diabetes. Thus Cannon presents a study of acidosis in 47 cases of shock, hemorrhage and gas infection. That impaired circulation would probably lead to acidosis was pointed out in 1910 by Yandell Henderson. In 1917 he revised his well-known acapnia theory of shock, and now interprets the low carbon dioxide content of the blood as probably not a primary acapnia, but as a consequence of acidosis.

Cannon's observations were made on the relation of acidosis to blood-pressure, pulse and respiration; the sugar-content of the blood; the effects of anesthesia and operation on existent acidosis and low blood-

⁴¹ Hospitalstidende, Copenhagen, 1918, lxi, 753, abstracted in Journal of the American Medical Association, 1918, lxxi, 694.

pressure, and the influence of alkaline treatment in cases of extreme acidosis. The results of these observations are summarized as follows: Cases of low blood-pressure due to shock, hemorrhage, or infection with the gas bacillus have a diminished supply of available alkali in the blood, that is, an acidosis. As a general rule, the lower the pressure the more marked the acidosis. The pulse is rapid in these cases, but does not vary with the degree of acidosis. The respiratory rate becomes more rapid as the acidosis increases until, shortly before death, a true "air hunger" may prevail. Blood sugar is usually somewhat increased above the normal in cases of shock and hemorrhage. The acidosis in these cases, therefore, is not due to lack of circulating carbohydrate.

Operation on men suffering from shock and acidosis results in serious and rapid sinking of arterial pressure when it is already low, and in marked and sudden decrease of the alkali reserve of the blood when that reserve likewise is already low. This change may not occur if nitrous oxide-oxygen anesthesia, instead of ether, is employed, but that anesthetic affords no guarantee against the ominous decline.

Shocked men suffering after operation from extreme acidosis with "air hunger" can be quickly relieved of their distress by intravenous injection of a solution of sodium bicarbonate and their blood-pressure restored to normal.

ACIDOSIS IN EXPERIMENTAL SHOCK has been studied by McEllroy,⁴² with the conclusion that acidosis is not the cause, but one of the secondary changes associated with this condition. Dogs were shocked by prolonged strong rhythmic stimulation of the afferent nerves under ether anesthesia. Under such circumstances the time required to establish the condition varied greatly in different animals. When necessary, the onset of the condition was hastened by other means, such as exposure and manipulation of the abdominal viscera. In later experiments, peripheral nerve stimulation, combined with partial cerebral anemia, was found to be the most satisfactory procedure yet employed in refractory cases. Anemia was produced by temporary occlusion of arteries supplying the medulla and brain. It should be noted that blood was always lost, but the quantity was not great, being limited to the amount unavoidably escaping from operative procedures and samples withdrawn at intervals for analyses. Experimental primary acidosis was produced by the intravenous injection of lactic acid, by which the reserve alkalinity could be lowered at will. When the reserve alkalinity had been lowered within the range observed in shocked animals, no change could be noted in the condition of the animal. It was necessary to lower the reserve alkalinity from 10 to 15 per cent. of carbon dioxide by volume below the range of shocked animals before a material fall in blood-pressure occurred. The further injection of acid produced a rapid fall in blood-pressure to a very low level, with cardiac and respiratory failure. At this point artificial respiration and cardiac massage alone were ineffectual, but, combined with the injection of sodium bicarbonate, produced prompt recovery and return of reserve alkalinity to normal.

⁴² Journal of the American Medical Association, 1918, lxx, 846.

McEllroy found that in the type of experimental shock studied there was a gradual decrease in the reserve alkalinity of the blood. The decrease varied in different animals. Anesthesia was an important factor. In some instances, the reserve alkalinity in shock was as great as in other animals before shock. This shows that acidosis was not an important causative factor. In no case was a change in reserve alkalinity sufficient to account for the condition observed.

In experimental primary acidosis, the alkali reserve may be lowered to a degree observed in shock without producing any marked change in the condition of the animal.

The injection of sodium bicarbonate into animals reduced to a terminal state by injection of acid resulted in prompt recovery. The injection of sodium bicarbonate into animals in shock was without beneficial action, although the reserve alkali was restored.

Shock may be induced while the alkali reserve is maintained by injection of sodium bicarbonate.

The etiology of shock will be considered at length in succeeding chapters under the caption "The Blood Volume."

Acidosis and Menstruation. Harrop and Mosenthal⁴³ report an interesting case showing the influence of menstruation on acidosis in diabetes mellitus. A girl, aged eighteen years, entered the hospital suffering from a very severe type of diabetes mellitus, accompanied by a marked degree of acidosis. The urine could be rendered sugar-free only temporarily by means of starvation; the acid substances in the urine were fairly high, the percentage of ammonia nitrogen of the total urinary nitrogen was well above the normal, and the carbon-dioxide tension of the alveolar air was low, in spite of the large amounts of bicarbonate of soda administered. The patient was thin and weak, but exhibited none of the distressing subjective symptoms that are often associated with marked acidosis and impending diabetic coma. The gravity of the situation was realized, and every effort was made to improve the girl's condition. At the end of one month, the acidosis had somewhat diminished, but the tolerance for carbohydrates had not increased at all. She was evidently one of the rare, but unfortunate, cases of diabetes mellitus which are not relieved by the starvation treatment. With the onset of the menstrual period, the picture changed completely. On that day she complained of abdominal pain and refused food. At 7 P.M. a change in the character of the breathing, with increasing drowsiness, was noticed, and at 10 P.M. there was well-marked hyperpnea; she could scarcely be aroused; there was marked involuntary twitching of the facial muscles, and the carbon-dioxide tension of the alveolar air was 20 mm.

The next day the symptoms remained unchanged. On the third day the conditions improved somewhat and on the fourth day all the symptoms, which had manifested themselves at the time menstruation began, disappeared. The patient was treated with large doses of sodium bicarbonate by the mouth, rectum and intravenously, and by starvation. The effects of this therapy were satisfactory. The tests during this

⁴³ Johns Hopkins Bulletin, 1918, xxix, 161.

period, which may be regarded as one of diabetic coma, show no appreciable increase in the severity of the acidosis over that of one month previously, when there were no subjective symptoms of acidosis. There is perhaps a slight tendency toward a rise in the amount of acid substances and ammonia, but no significant change occurred. The alveolar air showed a lower tension of carbon dioxide on the first day of menstruation than had previously been recorded, but here again the difference was only slight. It may, therefore, be concluded that the process of menstruation in some manner affected the body so that it was less resistant to the influences of the acid bodies and that diabetic coma resulted. With each following menstruation the symptoms became more marked until death occurred on the third day following the beginning of the menstrual period and thirty-six hours after the onset of coma.

DETECTION OF ACIDOSIS BY EXAMINATION OF SPINAL FLUID. J. F. McClendon,⁴⁴ in a study of the formation and composition of the cerebrospinal fluid, points out a simple method of detecting acidosis and determining hydrogen in concentration by the examination of the fluid. Since, as McClendon points out, a lowering of the alkaline reserve of the blood causes a lowering of that of the spinal fluid, any dangerous degree of acidosis, that is, the lowering of the alkaline reserve of the whole body, should cause a noticeable change in the spinal fluid. He points out that in applying the electrometric method to the spinal fluid it is possible to titrate the fluid with a suitable indicator because of the low protein concentration. It was found that dibromorthocresolsulphonephthalein was admirable in the titration of spinal fluid into which no hemorrhage has taken place. He gives the following technic:

One c.c. of spinal fluid is carefully measured in a volumetric pipette and run into a porcelain dish. Enough of an alcoholic solution of the indicator is added to turn it a distinct purple. The burette is improvised out of a 1 c.c. pipette, graduated in hundredths of a cubic centimeter. To the lower end of the pipette is attached a short piece of rubber tubing of 1 mm. bore. Into the lower end of the rubber tubing a piece of small glass tubing is inserted. The glass tubing is drawn out in a flame to a capillary tip. The rubber tubing is closed by means of a small clip of the type of crossed forceps or the bulldog or the Langenbeck clip. When the titration is made the burette is filled with tenth-normal hydrochloric acid. The acid is run in, a small portion at a time, and is mixed with the spinal fluid by being shaken in the porcelain dish until the color changes to yellow. It will be noted that the purple color may return on further agitation and that the end-point is reached only when the purple fails to return. In order to reach the end-point exactly, it is necessary to split drops. That is to say, the drops that fall by gravity are too large; and when a very small drop of hydrochloric acid is allowed to form on the tip of the glass tubing, it is transferred by touching the porcelain dish a short distance above the surface of the spinal fluid, and then is thoroughly mixed by agitation of the dish.

The results are put down as in the ordinary titration of an alkali

⁴⁴ Journal of the American Medical Association, 1918, lxx, 977.

with tenth-normal hydrochloric acid; for instance, ordinarily 1 c.c. of spinal fluid requires 0.275 c.c. of tenth-normal hydrochloric acid. In other words, the spinal fluid is 0.0275 normal in "alkalinity," or, as is more properly stated, in "alkaline reserve." This alkali exists almost entirely in the form of sodium bicarbonate, and therefore during the titration the fluid must be agitated until the carbon dioxide is expelled before the titration is complete. It is unnecessary, however, to boil in order to expel the carbon dioxide.

DISORDERS OF THE GLANDS OF INTERNAL SECRETION

Endocrine Disorders in Military Practice. It is not to be wondered at that with our increasing knowledge of the endocrine glands a number of articles would appear emphasizing the importance of their study in military practice. Sajous⁴⁵ points out that in civil life emotional stress of any kind, fright particularly, in the course of accidents accompanied by traumatisms or blows, car or train disasters, mental distress, worry, violent emotions, etc., are familiar causes of Graves's disease. That the exigencies of service in the field, the intense excitement, stress and apprehension provoked by modern methods of warfare, shell-fire, bombs, rapid-fire guns, etc., should prove a prolific source of hyperthyroidia, and its aggravated form is self-evident. Beebe⁴⁶ recalls that cases of severe hyperthyroidism were numerous after the Kishineff massacre in Russia and the San Francisco earthquake. He further states that, as far as he can learn, no special provision has been made at present for this class of patients. They need and deserve such care. The early stage of the disease is the most easily remedied and its early recognition and proper treatment is, therefore, a part of the great struggle.

The relationship of the endocrine glands to military conditions, especially the thyroid and adrenal, is so clearly set forth by Hurst in this year's edition of his *Medical Diseases of the War*, London, 1918, 35, that I am quoting direct. The emotion of fear is related to the instinct of flight and the emotion of anger to the instinct of combat. McDougall's psychological studies on this subject have been amplified by the physiological investigations of Cannon and of Crile and their co-workers. The physical manifestations of fear and anger are identical with those of such forms of violent exertion as flight and combat, which were the natural sequels of these emotions in primitive man.

Strenuous action is normally rendered possible by the sympathetic nervous system, which is stimulated to great activity by the emotions of fear and anger under conditions which imperil the safety of the individual. Impulses reaching the suprarenal glands by their sympathetic nervous supply stimulate them to secrete adrenalin. It has been shown experimentally that both the injection of adrenalin and the increased secretory activity of the suprarenal glands, which occurs in times of stress, give rise to all the effects produced by stimulation of the sympathetic nerves. Suprarenal activity thus powerfully reinforces the

⁴⁵ Pennsylvania Medical Journal, 1919, xxii, 215.

⁴⁶ Medical Record, 1918, xciii, 237.

direct action of the sympathetic nervous system, which enables the individual to respond to the emotions of fear and anger by strenuous action. There are no constrictor fibers to the cerebral and pulmonary arteries, and the sympathetic fibers to the coronary vessels produce dilatation instead of constriction, so that the vasoconstriction produced by adrenalin is confined to the splanchnic system; the blood-pressure is thus raised and the blood is driven to the heart, lungs, brain and muscles from the abdominal viscera, the action of which is simultaneously suspended by the inhibitory action of the sympathetic nerves on the secretion of gastric and pancreatic juice and bile and on the movements of the stomach and intestines. At the same time the heart is stimulated to beat more rapidly and vigorously. The skeletal muscles not only receive an increased supply of blood, but also of the sugar required for their activity, as adrenalin augments the stimulating action of the sympathetic on the production of sugar from the glycogen in the liver. The products of muscular activity, the accumulation of which leads to exhaustion, are neutralized or destroyed by adrenalin independently of any sympathetic action. The central nervous system, the heart, and the muscles of the limbs and trunk are thus prepared for great activity at the expense of the digestive organs, which do not contribute to the efficiency of the individual during strenuous exertion. The evaporation of sweat, the secretion of which is increased, prevents the rise of temperature, which would otherwise occur with excessive muscular activity, and the deep respiration and the relaxation of the bronchioles allow more oxygen to enter the lungs and excess of carbon dioxide to escape.

Cannon has shown that adrenalin increases the coagulability of the blood. Pain as well as anger and fear stimulates the secretion of adrenalin, and the pain caused by a wound thus helps to arrest the hemorrhage which would otherwise weaken the individual and prevent his escape.

The partial asphyxia which is the cause of the painful gasping caused by overexertion stimulates the secretion of adrenalin; the increased supply of sugar and of blood to the muscles, the diminution in muscular fatigue and the relaxation of the bronchioles which result are the cause of the "second wind" which makes the individual capable of renewed activity when he is about to fall a victim to his enemy, owing to being unable to continue in battle or flight after the initial secretion produced by anger or fear is beginning to wane.

Adrenalin acts very rapidly, but for a short period, as it is quickly oxidized. It is consequently of special importance when an emotion calls for sudden activity. When more prolonged activity is required, the internal secretion of the thyroid gland probably helps to maintain the activity initiated by adrenalin, as it acts after a longer latent period and its action is more prolonged. Unfortunately, experimental evidence for this is lacking, as there are no biological tests for thyroid secretion similar to those which proved the presence of excess of adrenalin in the blood.

The physiological effects of the fury and excitement of battle enable the born soldier to perform feats of strength and endurance which may be in striking contrast to his comparatively feeble physique. But the

changes which accompany fear and anger are entirely useless if the emotions are not followed by the associated instinctive activity. So fixed, however, is the primitive association of anger with fight and fear with flight, that when the natural sequels of these emotions are restrained, they continue to give rise to suprarenal and probably thyroid activity.

Thus, the ceaseless fear felt by the constitutionally timid when exposed to the horrors of war results in constant oversecretion of the suprarenal and thyroid glands, the physiological results of which are not followed by the muscular activity of flight for which they are the preparation. The unexpended energy may be so extreme that the soldier is incapacitated by it. On reaching the safety of a base hospital, the hyperactivity of the suprarenal and thyroid glands and the signs and symptoms to which they give rise often disappear. But they may be perpetuated by war-dreams, and in severe cases the mind is absorbed by day as well as by night by pictures of the horrors which the individual has witnessed; every sound reminds him of shells and every movement suggests the approach of danger. The activity of the suprarenal and thyroid glands is consequently maintained, and the patient presents a picture suggestive of Graves's disease, although hyperactivity of the suprarenal glands is probably of more importance though less easily recognized than that of the thyroid. The pulse is rapid, especially on the slightest exertion, and the heart may be slightly enlarged, but there are generally no murmurs. The blood-pressure of the average soldier in the front line trenches is slightly subnormal, but in these cases it is always raised while the patient is at the casualty clearing station, and it is often 150 to 160 mm., or in severe cases even as high as 180 mm. of mercury on arrival in England. Menard happened to be measuring the blood-pressure of a man a few seconds before a shell exploded in the immediate neighborhood. It at once rose from 125 mm. of mercury to 130, and ten minutes later was 150; an hour later it had again fallen to 125 mm.

The circulatory symptoms may be so prominent that the case is often diagnosed as "disordered action of the heart." The condition may then be described as the "hormonic type of soldier's heart." Excessive sweating often occurs, sometimes in paroxysms, especially over the palms of the hands and soles of the feet, and the patient often loses weight. The hands, and occasionally the eyelids, are tremulous, and the patient is highly nervous and excitable. The eyes are often slightly prominent and von Graefe's sign may be obtained. The thyroid gland, though overactive, is generally not obviously enlarged, but in some cases moderate enlargement is present. McNee and Dunn have found that the average weight of the thyroid gland in 65 apparently healthy men killed in action was 26.7 gm.—notably above the normal for civilian men of corresponding age—although there were no external signs of enlargement.

Though hyperthyroidism is the most obvious condition present, it is not the most important, as in all probability it is accompanied by hyperadrenalism, which accounts for the high blood-pressure, and perhaps for the exaggerated pilomotorvasodilator cutaneous reflex.

Considering that adrenalin gives rise to an increased production of

sugar, glycosuria has been a less common result of the stress of active service than might have been expected. It seems to have been observed much more often among German than British soldiers. Among 250 diabetic soldiers treated by Lenné at Neuenahr, only 5 were predisposed by their family history and only 27 had had glycosuria before. In 95 the onset had been acute with sudden great thirst, and in many the conditions seemed clearly to be the direct result of exhaustion and mental strain.

Thyroid. THE FREQUENCY AND MANIFESTATIONS OF GOITRE AMONG ENLISTED MEN. Smith⁴⁷ reports a statistical study of simple toxic goitre at Jefferson Barracks, Mo. Among 65,507 men examined, an enlargement of the thyroid was noticed in 1074 instances (1.63 per cent.). In 116 cases (10.7 per cent.) there were toxic symptoms. These men were rejected with a diagnosis of hyperthyroidism or exophthalmic goitre, depending on whether or not exophthalmos was present.

The men from whom these figures are compiled are between the ages of eighteen and thirty-one years, and, as the table indicates, represent widely scattered areas of a wide section of the country, none of which are free from goitre. Contrary to the prevailing conception, the states in the Great Lakes region stand rather low in the list with regard to the percentage both of simple and of toxic goitre. In 100 cases of toxic goitre, a careful study was made of the subjective symptoms and physical findings.

Fifteen (15 per cent.) of these men apparently felt as well as ever, except that they had noticed they were more irritable than usual and had been wakeful at nights during the past few months. Sixty-six complained of palpitation of the heart. This and nervousness were the most common subjective symptoms. Forty-eight had attacks of dizziness. Fifty-four became short of breath easily and had a feeling of exhaustion on exercise. Thirty-nine complained of precordial pain. Twenty-nine perspired very freely and had hot flushes of the face and hands. These symptoms were all aggravated by physical strain and excitement. The nervous strain of the examination and the new environment were especially noticeable.

In the physical examination the thyroid gland was found enlarged in every instance. In many the enlargement was slight, and in a few cases well down under the sternum. Usually the subject was not aware of any increase in the size of the neck.

The tachycardia attracted the attention of the examiner and was invariably the reason given for referring the subject to the cardiovascular board. The pulse-rate in a recumbent position before exercise ranged from 90 to 160 per minute. In only 6 instances (6 per cent.) was the rate below 100. In 15, it was from 100 to 110; 16, from 110 to 120; 22, from 120 to 130; 20, from 130 to 140; 16, from 140 to 150, and 2, from 150 to 160 a minute. The pulse-rate, as a rule, was very unstable, increasing rapidly with exercise or excitement. The latter was often noticed when the stethoscope was placed to the precordium.

⁴⁷ Journal of the American Medical Association, 1919, lxxii, 471.

The apex impulse was in the fifth interspace in every instance, varying from 6.5 to 8.5 cm. from the midsternal line. In 49 cases there was a soft systolic murmur at the apex which was often heard at the base on the left side. In every instance this was cardiorespiratory in type. The systolic blood-pressure was usually increased. In 51 cases the systolic pressure was above 140 mm. of mercury.

GOITRE IN PREGNANCY. It is not uncommon to find a so-called physiological enlargement of the thyroid gland during pregnancy. Exophthalmic goitre, however, is rare. Watson⁴⁸ reports 7 cases of toxic goitre with exophthalmos, and 9 cases of toxic goitre without exophthalmos, occurring during pregnancy seen during the past five years. Hyperthyroidism is not as rare in pregnancy as some would have us believe. Watson states that occasionally patients with goitre of brief duration ascribe their increase in symptoms at pregnancy to the pregnancy itself, while in reality the symptoms are due to a beginning hyperthyroidism. There is no doubt that some of these patients are treated for neurasthenia, hysteria, palpitation of the heart, and gastro-intestinal and nervous disorders. Many physicians do not regard goitre seriously unless it is accompanied by marked exophthalmos. At any rate, we should be more on the alert for this condition, and many questionable cases should receive more painstaking diagnosis and more continued observation.

The subjective thyroid disturbances are usually most pronounced during the first two to four months of pregnancy. After the fifth month, subjective improvement usually occurs or the symptoms increase and hyperplasia develops with or without exophthalmos. The patient with increasing symptoms of hyperthyroidism is liable to have hemorrhages and abort. Watson concludes from his study that:

1. Preëxisting goitre, either simple or toxic in type, is usually aggravated by pregnancy.

2. It is believed that the symptoms and growth of hyperplastic goitre in pregnancy can usually be controlled by quinine and urea injections into a portion of the thyroid gland.

3. Should symptoms progress in spite of conservative measures a rapid delivery is indicated. If the child is viable, Cesarean section should be done.

4. Operation on the thyroid is indicated to relieve pressure symptoms of solid goitres. Cystic goitre may be promptly relieved by quinine and urea injections.

5. Pregnant women with subthyroid conditions should receive iodides or thyroid throughout gestation.

C. H. Mayo,⁴⁹ in discussing Watson's paper, stated if iodine is supplied to the thyroid the gland becomes reduced, since it does not have to do so much work. It seems to him that if pregnant women who have goitres could get iodine the thyroid would convert it into the thyroidal iodine that is needed in the body. He has seen patients with exophthalmic goitre run through three pregnancies, and they were very much better during the pregnancy period than they had been preceding it.

⁴⁸ Journal of the American Medical Association, 1918, lxxi, 875.

⁴⁹ Ibid., 877.

Some such patients are worse during the pregnancy period. He does not care to operate on the pregnant woman with goitre. If possible, she should be tided through pregnancy. In many instances, after the birth of a child, the goitre will disappear almost wholly. After watching the work of Crile, who injected into the tissues about the operative field quinine and urea to block the innervation, it occurred to him that if the infiltration did block, why should he not inject the gland itself and create the edema within its own capsule, as in cloudy swelling of the kidney, that would check off the secretions and the ability to take the blood supply. He began making these injections about three years ago, and has reported some cases. The action is about the same as in the injection of boiling water, though much less severe. He had three patients with exophthalmic goitre die from the injection of hot water. They were treated in their beds to prevent shock; the water was probably not hot enough to coagulate albumin, and possibly more easily enabled the gland to throw off the hormones of secretion. He used the quinine and the urea to make a block within the substance of the gland itself, and not so much as a destroying agent. Many of these cases are necessary for a determination of the best treatment. Mayo is inclined to believe that the tendency is toward improvement, and that in only the bad cases should any form of surgery be done during pregnancy.

EXOPTHALMIC GOITRE IN CHILDREN is rarely found. Gram⁵⁰ refers to Sattler, who could find records of only 184 children under fifteen in 3477 cases of exophthalmic goitre on record. At the same time it is not infrequent to encounter, in girls approaching puberty, some slight enlargement of the thyroid with mild nervous manifestations and tendency to tachycardia—evidently a pathological exaggeration of the physiological hyperthyroidism at this time. Holmgren, in 1906, called attention to the excessive growth which occurs in these conditions. The growth seems to be whipped up, and the bones settle prematurely into a condition which normally would occur only four or five years later. The epiphyses become consolidated, so that growth has to cease after this spurt, the children not being exceptionally tall when they reach their majority. Gram here reports in detail three typical cases. The girls were harmoniously developed, with menstruation at twelve. At thirteen, they were 13.5 and 10 cm. taller than the average for their age. There were no signs of acromegaly.

ETIOLOGY OF EXOPHTHALMIC GOITRE. Wilson⁵¹ endeavored by experiments on animals to determine the effect directly on the cervical sympathetic ganglia and indirectly on the thyroid of various forms of stimulation applied to the ganglia. He found that the presence of certain bacteria within the cervical sympathetic ganglia may produce histological pictures within the ganglia and in the thyroid which parallel those found in the various stages of progressive and regressive exophthalmic goitre. In Wilson's opinion, this evidence suggests that in exophthalmic goitre the thyroid receives its stimulus to overfunction

⁵⁰ Hospitalstidende, Copenhagen, 1918, lxi, 913, abstracted in Journal of the American Medical Association, 1918, lxxi, 1178.

⁵¹ American Journal of the Medical Sciences, 1918, clvi, 553.

through its nerve supply, and as a result usually of a local infection in the cervical sympathetic ganglia.

CLINICAL MANIFESTATIONS OF EXOPHTHALMIC GOITRE. These have been described so often that those articles which have appeared during the year are for the most part repetitions or reiterations of those descriptions which may be found in the monographs or systems of medicine. Barker's⁵² paper, however, before the Section of Nervous and Mental Diseases at Atlantic City, June, 1918, emphasizes the relationship, which we must keep constantly in mind, of the endocrine system and nervous system as illustrated in the symptomatology of exophthalmic goitre. He enumerates the symptoms referable to disturbances of the vegetative nervous system as follows:

(a) In the head and neck: (1) Von Graefe's sign, (2) Dalrymple's sign, (3) protrusion of the eyeballs, (4) epiphora in some, dry eyes in others, (5) Loewi's phenomenon, (6) excess or lack of saliva.

(b) In the respiratory system: (1) Asthmatic attacks, (2) dyspnea or tachypnea.

(c) In the circulatory system: (1) Tachycardia, (2) *pulsus irregularis respiratorius*, (3) vasomotor angina, (4) subjective palpitation, (5) transitory changes in blood-pressure, (6) vasomotor symptoms, especially temporary erythemas and dermographism.

(d) In the digestive system: (1) Gastrospasm and pylorospasm, (2) gastric hyperacidity or hypacidity, (3) spastic constipation, (4) unmotivated watery, painless diarrheas and unmotivated vomiting.

(e) In the urogenital system: (1) Pollakiuria, polyuria and oliguria, (2) certain disturbances of menstruation and of lactation, (3) certain disturbances of sexual libido and potentia.

(f) In the cutaneous glandular system: (1) Profuse sweating (and Vigouroux's sign, which is probably dependent on it).

The phenomena referable to the periphery neurons of the cerebrospinal system include toxic degenerative processes involving both motor and sensory nerves (rarely). Palsy of the cerebral nerves are not infrequently met with, especially those supplying the eye muscle. He refers to Kappis's collection, in 1911, of 40 cases in which ophthalmoplegias of varying grade were encountered in exophthalmic goitre in the absence of any other involvement of the cerebral nerves. He states that most interesting of all in the disease are the cases of palsy in the domain of several cerebral nerves, yielding the clinical picture of an acute, a subacute, or a chronic, bulbar paralysis. It has sometimes been difficult, apparently, to differentiate cases of "bulbar paralysis with anatomical lesion" from the cases of myasthenia gravis (or "bulbar paralysis without anatomical lesion") not so very infrequently met with in association with exophthalmic goitre. Further study is needed to decide the importance or unimportance of thymus hyperplasia in these groups of cases. What has always surprised me most in the study of patients exhibiting exophthalmic goitre, as far as the peripheral nerves are concerned, has been the constant presence of extensive evidence of disturbed function

⁵² Journal of the American Medical Association, 1918, lxxi, 327.

of the peripheral autonomic nerves in contrast with the apparent absence of evidence of disturbance of function (except in rare instances) of the peripheral cerebrospinal nerves.

With regard to the phenomena referable to the brain and cord, Barker states that of the grosser organic lesions occasionally encountered, such as tabes, apoplexy, etc., none seem to stand in any direct relationship. With regard to apoplexy, it may be well to speak with reserve, despite clinical impressions. Most interesting are the psychic symptoms manifested by patients with exophthalmic goitre. The frequency of neurasthenic states, of anxiety states, and of phobic and obsessional states in patients suffering from the disease is notorious. Indeed, it is on account of the symptoms of such states that the patient most often applies, or is brought by a member of the family, to the physician for relief.

Outspoken psychoses (maniacal, melancholic, paranoid) are by no means uncommon in exophthalmic goitre, especially when there is a psychopathic heredity. Even in milder cases of exophthalmic goitre, complaints of nervousness, irritability, inability to concentrate, headache, insomnia, pains in the eyes, pressure in the head, throbbing of the vessels, internal quivering, hot flushes, fatigability, dyspnea, anorexia and nausea are very common.

The cardiovascular symptoms of exophthalmic goitre are not without comment. We speak of tachycardia and imagine we have discussed the subject. Krumbhaar⁵³ examined further, by means of the electrocardiograph, 51 cases of goitre, mostly of the toxic type, in as many cases as possible both before and after surgical operation. In the series of 47 patients that submitted to surgical operation (ligation, partial excision, and enucleation of adenomas) 3 deaths occurred; 2 of these offered no premonitory signs in either clinical or electrocardiographic examination; in the third case the development of negative *T* waves might have served as an adequate warning. Electrocardiograms, essentially normal as to form and rhythm, were found in 22 cases (43 per cent.). Preponderating hypertrophy of the right ventricle (or a tendency thereto) was found in 11 cases, and of the left ventricle (or a tendency thereto) also in 11 cases. After operation, however, one-half of the right ventricular cases showed a diminished degree of preponderance, whereas all but one of the left ventricular cases showed either no change or an increased amount of preponderance. Cardiac arrhythmia was found as follows: Sinus arrhythmia, 4 cases; ventricular extrasystoles, 3 cases; auricular fibrillation, 3 cases; auricular flutter, 1 case; delayed conductivity, 2 cases.

THE CHEMICAL NATURE AND PHYSIOLOGICAL ACTION OF THE THYROID SUBSTANCES. Since Baumann, in 1906, discovered that iodine is a normal constituent of the thyroid gland, various attempts have been made to isolate the pure crystalline form of the compound containing the iodine. Kendall,⁵⁴ whose various attempts have been reviewed in *PROGRESSIVE MEDICINE*, has at last succeeded—only after, however, the

⁵³ American Journal of the Medical Sciences, 1918, clv, 175.

⁵⁴ Journal of the American Medical Association, 1918, lxxi, 871.

most painstaking search, during which "eight years of practically continuous investigation and more than 2 tons of thyroid glands have been used." Some 20 gm. of the active constituent in pure crystalline form have been separated. The investigation, besides involving the separation of this substance, has also included the determination of its chemical formula, both empiric and structural, together with its synthesis, and the investigation of its physiological action as well as the treatment of clinical conditions. The ultimate analysis of the compound is: C, 22.74; H, 1.72; O, 8.21; N, 2.38; I, 65.10.

To those who are interested in the detailed chemistry of this substance, reference is made to the original article. The substance is called thyroxin. The physiological investigation of this substance has demonstrated that in pure crystalline form it will increase the energy output of the animal organism. In emphasizing this fact, Kendall uses Plummer's explanation for the function of the substance. Heretofore the activity of the thyroid has been studied and expressed mainly in clinical terms. Instead of saying that this iodine compound will relieve the symptoms of myxedema, that it will produce hyperthyroidism, that it has this or that effect on the kymograph, that it affects the pulse-rate, blood-pressure, nitrogen metabolism, etc., he states its action in a definitely measurable quantity: One-third of 1 mg. of this substance increases the basal metabolic rate of an individual weighing approximately 150 pounds, 1 per cent. If the basal metabolic rate of an individual of this weight is 30 per cent. below normal, the administration of 10 mg. will raise the metabolic rate to normal; and if it is 21 per cent. below normal, the administration of 7 mg. will raise it to normal. The administration of greater amounts of the substance will increase the basal metabolic rate to a figure just as high as is compatible with life. The metabolic studies which have thus been made possible as a result of Kendall's work are so far-reaching in their importance that I am quoting him at length.

Plummer's definition for the function of the thyroid is that it determines the amount of energy that any given cell within the body can produce on stimulation either from within or without. It determines the quantum of energy that is possible for any given cell to produce. When this is emphasized and the problem is faced in this light, the question of the function of the thyroid assumes an entirely new aspect.

The moment the metabolic rate increases, fundamental changes are produced; for instance, the pulse-rate increases, the pulse pressure must increase, the rate of blood flow must increase, and if pushed long enough the body sugar, fat and proteins will be used up in greater amount than normal, meaning an increase in the carbon dioxide output and oxygen consumption, and an increase in nitrogen elimination. Symptoms due to subnormal activity of tissues will be relieved; in other words, the condition of myxedema will disappear. If the metabolic rate is carried high enough, so high that it approaches that found in hyperthyroidism, then the symptoms of hyperthyroidism will appear. All this has been demonstrated in a very large number of cases at the Mayo Clinic, so that not only has Plummer shown that this substance is physiologically

active, but he has expressed with mathematical exactness the function of the gland, as well as the normal physiology involved when the secretion of the thyroid functionates. This addition to our knowledge of physiology is incomparably greater than merely the knowledge that a certain substance isolated from the thyroid happens to possess demonstrable physiological activity. Plummer's conclusions are based on his own observations, made in thousands of cases of goitre, and on his knowledge of physiology. It is possible that these conclusions could not have been satisfactorily proved from existing data, but by the use of this substance as a tool, his hypothesis has been entirely substantiated and now the function of the thyroid can be expressed as a physiological process and not in terms of anatomical changes and clinical syndromes.

Patients with complete atrophy of the thyroid have basal metabolic rates approximately 40 per cent. below normal. It has been shown that the administration of thyroxin alone can bring back and maintain the normal metabolic rate in these persons. But in complete atrophy of the thyroid, the complete or nearly complete absence of thyroxin may be assumed. The question arises as to what maintains energy output from 100 per cent. below normal, which would be death, up to 40 per cent. below normal, the point to which basal metabolism sinks in the absence of thyroxin. May it not be the other chemical substances in the body possessing the same grouping that occurs in thyroxin? These are amino-acids and proteins, creatin and creatinin, and few other less well-known compounds. It seems probable that, on the administration of thyroxin, a reaction that has been carried on within the body by other compounds is merely increased in rate, but that there is no other difference or disturbance of the reactions that have been going on.

In regard to the relation of iodine to the activity of thyroxin, the presence of iodine in the compound must exert some influence, and it seems not improbable that the presence of iodine renders the active groups more reactive. In the absence of iodine it would take a greater working pressure to bring about the reaction. The exact chemical reactions in the body when this substance functions are still unknown, but, thanks to the studies of Kendall and of Plummer, we have a clearer conception of the thyroid function.

LINGUAL GOITRE. Two cases of aberrant thyroid tissue at the base of the tongue are reported by Jorge and Layera.⁵⁵ They tabulate 46 cases from the literature. With regard to the condition, they state that during the day there is only slight, if any, interference with breathing even when the epiglottis is pushed aside by the tumor. But at night, when the muscles of the tongue relax in sleep, there may be episodes of suffocation in certain positions. The tumor may escape detection unless an effort is made to arch the tongue at its base; this throws the tumor into view. The laboratory will exclude syphilis and tuberculosis. With any aberrant goitre, it is necessary to determine whether there is any tendency to thyroid deficit before attempting to remove any or part of the tumor. They regard this as so important that they advise

⁵⁵ *Revista de la Asociación Médica, Buenos Aires*, 1918, xxix, 246, abstracted in *Journal of the American Medical Association*, December 28, 1918.

an exploratory incision of the normal thyroid before venturing to remove an aberrant thyroid tumor. Whatever technic is followed for removal of the tumor, tracheotomy seems to be indispensable not only to maintain the respiration but for information in regard to the natural thyroid. Two of the total 50 cases were in infants; there was recurrence after operation in 6 cases, and postoperative myxedema developed in 7. The lingual goitre contained patches of calcareous degeneration in the one case in which the tumor was removed through an incision. In the other case it was removed through the mouth under local anesthesia. In 2 cases the natural thyroid was lacking, and symptoms of myxedema contra-indicated any operation.

CANCER OF THYROID. From the Mayo Clinic comes the report by Balfour⁵⁶ of 103 cases of thyroid cancer among 6359 cases of goitre, exclusive of the exophthalmic group, or 1.6 per cent. Of the 103 patients, 81.5 per cent. were more than 40 years old. Sixty-eight (68 per cent.) of the patients were females, 35 (35 per cent.) were males. The most important lesson to be drawn from an analysis of these cases, Balfour says, is the fact that in 46 per cent. no clinical manifestations of the disease were in evidence. This group shows by far the highest percentage (about 70) of patients free from recurrence at the present time. In other words, the great majority of apparent cures have occurred in those cases in which the malignant change was an unexpected finding. Total thyroidectomy was rarely performed in this group. In most instances the lobe containing the tumor and the malignant process was removed, but in many the enucleation of an adenoma was the procedure. The analysis showed also that, when clinical evidences of cancer are present, the results of surgical treatment are discouraging. Total extirpation of the gland appears to be indicated only when both lobes are grossly involved in the disease, and when past experience warrants surgical interference in the particular case. Recognizable involvement of cervical glands usually means that the time for surgical cure is past. Occasionally, however, just as the unexpected occurs in the treatment of extensive cancer elsewhere, an apparent cure is obtained. Gross involvement of trachea or esophagus is almost a certain sign against curability. In this series the average number of years of abnormal growth in the thyroid preceding the operation was 11.6. This Balfour regards as being proof positive of the advisability of the early removal of well-developed thyroid nodules.

TREATMENT OF GOITRE. Nothing new has appeared in the treatment of toxic or non-toxic goitre. The work of Kendall and of Plummer has gone a long way toward defining our indications for operation and toward telling how much thyroid surgery has to do in the treatment of exophthalmic goitre. With regard to the simple goitres of adolescence, Mayo states that only such of them require operation as are troublesome because of pressure or are unsightly and resist treatment. In some persons they are associated with a demand of the body for thyroxin, and iodine in most any form relieves the gland of its colloid. The gland

⁵⁶ Medical Record, 1918, xciv, 847.

is not hyperplastic. In persons under twenty-five years of age, small adenomas in the thyroid and the simple colloid goitres are only occasionally recommended for surgery. Later in life, the degenerations which occur in goitres of long standing, such as encapsulated adenomas and encapsulated colloid areas, when the secretion has become reduced, may develop thyrotoxic conditions. Kocher pointed out the fact that the degenerations often occur in women, from forty to sixty years of age, whose goitres of long standing are altered by iodine treatment. The older the person when goitre develops, the more quickly must degeneration occur. These patients have staring, but not protruding eyes, widening of the fissure through sagging of the lower lid, and, because of the rapid pulse and tremor, the condition is often looked on as exophthalmic goitre. Plummer has pointed out the distinction between this condition and exophthalmic goitre.

In the treatment of ordinary goitre, the *roentgen ray* has been used at times with reported good results. That it is not without danger is emphasized by Secher⁵⁷ who cites several cases in which an ordinary goitre became transformed into the toxic type under roentgen treatment. The thyroid may thus be stimulated to excessive function or reduced function; the latter is less common. There is a definite danger in exophthalmic goitre that the hyperthyroidism may be fatally aggravated, as in Secher's case. The symptoms in his patient became much aggravated at once, with restlessness, choreiform movements, tachycardia 100 to 200, heart-beat up to 240, respiration 72 and death on the fifth day. Another observer, Nordentoft,⁵⁸ is most enthusiastic about the use of the roentgen ray in treatment. In a detailed report of 50 cases, more or less benefit was obtained in all and the improvement persisted to the date of writing. Nordentoft emphasizes the importance of exposing the thymus as well as the thyroid to the ray, as he is convinced that the thymus is an important factor in certain cases of exophthalmic goitre (see Thymus).

Pituitary Gland. PITUITARY INSUFFICIENCY. One of the most exhaustive articles of the year is that by Pincherle,⁵⁹ who tabulates 116 cases of pituitary insufficiency from the literature and gives seven pages of bibliography. He compares this testimony with his own clinical experience which amply confirms the connection between abnormal polyuria and backward physical development and pituitary insufficiency. Corroborating minor signs are the effects of pituitary treatment, the extreme tolerance for carbohydrates, the abnormally small sella turcica, anomalies in ossification, and Cushing's thermoreaction, low blood-pressure, asthenia and drowsiness. In some of his cases only some of these minor points were evident, and he classifies them as "masked pituitary syndromes." They are important for research on the endocrine system, but the chief importance of their discovery lies in the possibility of improvement and cure under organotherapy. In one of his patients the

⁵⁷ Ugesk. f. Laeger, Copenhagen, 1918, lxxx, 1613.

⁵⁸ Ibid., 1918, lxxx, 1331.

⁵⁹ Rivista di Clinica Pediatrica, 1918, xvi, 337, abstracted in Journal of the American Medical Association, 1918, lxxi, 2029.

arrival of puberty was accompanied by considerable development of fat, and menstruation was seriously irregular while some of the sexual characters were abnormal. Pituitary treatment in his case reduced the excessive diuresis and polydipsia, but did not seem to modify durably the diabetes insipidus. The children increased in height and weight, but not all the signs of backward physical development subsided. Enough were modified, however, to encourage further experiments in this line with great promise.

THE PATHOGENESIS OF DIABETES INSIPIDUS is discussed by Moreschi,⁶⁰ who believes, from the available information, that diabetes insipidus is the result of deficient pituitary functioning with more or less functional modification of the ductless glands, and hence of the work of the vegetative nervous system—an endocrine—sympathetic dystrophy. Other causes for diabetes insipidus may be found in changes in the mid-brain, particularly in the floor of the third ventricle, or in changes in the vegetative system from compression of the vagus or sympathetic by a tumor or aneurysm. The morbid conditions entailing the deficient functioning in the pituitary body may be from a tumor or chronic inflammatory lesions as well as from tuberculosis or syphilis or sclerosis of the gland. The occurrence of diabetes insipidus in early life is generally recognized. Dilluca⁶¹ records a very young patient, a male infant, in whom the polyuria was noted at three months. At three years of age he was drinking 4 liters a day and voiding an equal quantity of urine.

The factor which *syphilis* plays in the production of the disease is not clearly understood. Fitcher, some years ago, pointed out the association of brain syphilis with diabetes insipidus in 5 out of 9 cases. Fracassi⁶² reports the case of a young man who responded to mercurial treatment. His history was that within three months he developed polyuria up to 15 liters in twenty-four hours. He had a chancre six years before. In the last month there had been lightning pains in the legs and quite recently a little fever. All the symptoms subsided under mercurial treatment, the amount of urine dropping from 10,000 to 6500 c.c. in the course of eight daily intravenous mercurial injections. By the twentieth injection the daily output of urine was only 2000 c.c. Muniagurria has published a similar case of cure of diabetes insipidus under specific treatment.

The relation of *pituitary disturbances to the psychoses of adolescence* is discussed by Tucker.⁶³ There seems to be, according to this observer, definite reasons for believing that pituitary adolescent psychoses exist; that these psychoses may be divided into groups according to the clinical preadolescent status in comparison with the adolescent symptoms; that the roentgenographical findings correspond to the clinical type of the case, and that, in cases which show decreased pituitary secretion, the response to pituitary feeding is prompt and satisfactory. Tucker's classification follows:

⁶⁰ Policlinico, 1918, xxv, 97.

⁶¹ Semana Medica, Buenos Aires, 1918, xxv, 422.

⁶² Revista Medica del Rosario, Argentina, 1918, viii, 197, abstracted in Journal of the American Medical Association, 1918, lxxi, 1098.

⁶³ Journal of the American Medical Association, 1918, lxxi, 330.

FINDINGS IN PITUITARY PSYCHOSES OF ADOLESCENCE.¹

Classification.	Clinical findings.	Roentgen-ray findings.	Psychosis.	Incidence.
GROUP 1. Preadolescent oversecretion, with further increase during adolescence	Increase in body hair and sexual development and mentally precocious	Large sellæ, with regular contour and smooth clinoid processes	Prejudices and infatuations, increased libido, psychomotor acceleration, sudden changes in temperament and usually transient hallucinations	Rather frequent.
GROUP 2. Preadolescent oversecretion, with decreased secretion during adolescence	Same as Group 1, with ap-parent arrest at puberty	Large sellæ, with probably irregular outline and some thickening of posterior processes	Drowsiness or probably trance states, with disturbance of pulse and blood-pressure; other endocrine glands usually also affected	Rare.
GROUP 3 (A). Preadolescent normal secretion, with increased secretion during adolescence	Previous history normal, with marked increased libido and sex characteristics during adolescence	Not definite	Increase in libido and general nervousness, but rarely amount to definite psychoses.	Common in moderate degree, but mental changes rare.
GROUP 3 (B). Preadolescent normal secretion, with decreased secretion during adolescence	Previous history normal, or nearly so, with delayed adolescence, frequently increase in fat and sugar tolerance; appetite voracious; pulse often slow and blood-pressure low	General size of sellæ about normal, but thickening and enlargement of clinoid processes, especially the posterior; encroachment on fossæ usually shown	Dull, seclusive, self-absorbed; repetition of movement common; difficulty in expressing themselves in writing; unemotional, unaffectionate, obstinate, irritable; may or may not have hallucinations and delusions; resembles dementia precox	Frequent.
GROUP 4. Preadolescent undersecretion, with further decrease during adolescence	Previous history normal, usually increase in fat and sugar tolerance, underdevelopment of genitalia, lack of body hair, lessened perspiration, voracious appetite, delayed adolescence and often amenorrhea in female	General size of sellæ small, contour irregular, processes enlarged and encroach on fossæ and club or tend to bridge	Psychosis is usually not very profound; have dullness, irritability, tardiness, lack of ambition, often truancy and sometimes epileptoid convulsions	Rather frequent.

¹ Usually these psychoses are preceded by illness, injury or great change in environment.

Treatment of Diabetes Insipidus. Last year Barker and Mosenthal⁶⁴ described a case of diabetes insipidus treated by pituitary solution, and presented the literature upon the subject. During the past year additional experiences have been reported. For example, Rosenbloom's⁶⁵ patient, a boy aged twelve and a half years, had urinated excessively since he was three and a half years of age. The physical examination was negative except for bilateral temporal hemianopsia. The daily intake and output of fluids varied from 5000 to 9000 c.c. Thyroid tablets, 2 grains thrice daily, for four days, had no effect. Pituitary tablets, 5 grains daily, had no effect. The injection of pituitary solution in doses of 1 c.c. caused an immediate drop in the output and intake to less than half the average amount, a reduction which was maintained during the continuance of the injections. The effect of the injection lasted about twenty-four hours.

Lereboullet⁶⁶ has long proclaimed the advantages of pituitary treatment in diabetes insipidus. He discusses the ultimate outcome of a case previously published in which the man of twenty-four had seemed to stop developing at fourteen and presented eunuchoid infantilism with permanent polyuria, falling out of the teeth, and eruptions suggesting that besides the diabetes insipidus there were certain elements of diabetes mellitus. Alimentary glycosuria followed even 50 gm. of glucose. The output of urine was from 6 to 10 liters in twenty-four hours and pituitary treatment by the mouth did not modify it, but subcutaneous injection of 0.05 gm. pituitary extract, corresponding to half of the posterior lobe of a beef pituitary body, caused the urine to drop to 1 or 2 liters; appetite and sleep returned and the young man felt better, but this effect never lasted over twenty hours. He finally made the injections himself and kept them up for months. If they were suspended for twenty four hours the polyuria returned. After two years of this he had gained 3 cm. in height, the hair on his body had grown somewhat, and the testicles had descended. There was a return of the sexual function. The patient eventually died of pulmonary tuberculosis.

Moreschi⁶⁷ and Clausen⁶⁸ also report instances of prompt control of the polyuria by injections of pituitary solution.

We are forced to conclude that the polyuria responds promptly to the pituitary treatment and it should at least be tried in every case. Although the action lasts only for twenty-four hours, even this gives great relief whether its action is specific or merely symptomatic.

PITUITARY GLAND IN EPILEPTICS. Some years ago Shaw and Munson described some pituitary glands from epileptics and concluded that the gland was below the usual average weight. Recently Munson⁶⁹ made x-ray observations of the sella turcica in a series of unselected epileptic subjects and found that they presented a wide variation in type. The

⁶⁴ Journal of Urology, 1917, i, 449.

⁶⁵ Journal of the American Medical Association, 1918, lxx, 1292.

⁶⁶ Anales de la Facultad de Medicina, 1917, ii, 712, abstracted in Journal of the American Medical Association, 1918, lxxi, 1268.

⁶⁷ Policlinico, 1918, xxv, 97.

⁶⁸ American Journal of Diseases of Children, 1918, xvi, 195.

⁶⁹ Archives of Internal Medicine, 1918, xxi, 531.

average size was a trifle smaller than the figures given for normals and the contained gland seemed to weigh less.

Roofing will be seen in the roentgenogram, but in reality the gland is well exposed and pressure seems a remote possibility. Bony changes are present but seem to be the anomalies which might well be present in a similar series of non-epileptic cases. There is no characteristic change to be seen in epileptic sellas.

TUMORS OF THE PITUITARY. No new light has been shed on these neoplasms during the past year. The surgeons are active in the effort to perfect the technic of removal when such is possible. Certainly great progress along this line has been made within recent years, largely due to the influence of Cushing and others. As an example of what might be expected, when these cases are operated upon, we refer to the report of 6 cases so treated by Adson.⁷⁰ He describes a technic for removal and summarizes his results as follows: In 2 of the group of 6 cases, the patients presented very definite bitemporal hemianopsia, with more or less complete loss of vision in the left eye. One patient had a complete loss of vision in the right eye for a period of ten years, and a left temporal hemianopsia; one presented a typical acromegalic syndrome with a temporal color hemianopsia and constricted object field; one had bitemporal hemianopsia with more or less distorted fields in the left eye, and one had blindness in the right eye with definite neighborhood symptoms producing a frontal lobe syndrome of pressure and localization, involving the uncinate gyrus. Postoperative convalescence was uneventful and rapid in all but 1 case, in which the patient died on the second day. In 2 cases there was complete restoration of vision, in 2 marked improvement in vision, and in 1 a relief from headache. In the case of blindness in the right eye, which was complete for ten years, the patient has begun to have a return of vision. The patient with acromegaly is having metabolic changes. In 5 cases there has been definite improvement. In 1, no visual improvement, but relief from pain was obtained.

The Thymus. André Crotti's monograph on the *Thyroid and Thymus* is one of the important books of the year. I mention it here with special reference to the rather brief, though highly concentrated, section which presents our knowledge of the thymus gland, a knowledge which dates back to Polydeukes and Rufus, who were the first to mention it in the literature, to Vasal and Bartholonus, who were the first to give descriptions and pictures of it, and to Galen, who believed the word "thymus" came from the Greek, meaning courage, because of its intimate relation with the heart. The involution which the thymus undergoes after the period of development, *i. e.*, the eleventh to fifteenth year, is a matter of common knowledge. The exact function of the gland during development and the disorders of function are as yet imperfectly understood. We have come to know certain symptoms as indicative of thymic hyperplasia, which is not infrequently combined with concomitant hyperplasia of the entire lymphatic system (status thymolymphaticus). With regard to the patients, Crotti states that this condition is accompanied

⁷⁰ Journal of the American Medical Association, 1918, lxxi, 721.

by a reduced caliber of the aorta and of the arterial system. The patients affected with status thymolympathicus are pale, yellowish in color, although more or less well nourished. It is often said of them that they have a lymphatic habit, a condition which is more easily recognized than described. Such patients have a diminished resistance; they are more vulnerable to bacterial and toxic influences, and stand a good deal less than others. Their nervous system is impaired; their cardiac function, for some reason or other, is easily inhibited and death from cardiac paralysis in such cases is frequent.

The most striking symptom of thymic hyperplasia is dyspnea. It may be constant or paroxysmal. It is usually exaggerated by hyperextension of the head and by lying down. It may last a few minutes to many days. It is less frequent as the child grows older, as the superior opening of the thorax becomes larger. This opening is called the "critical space," and in young infants does not exceed 2 or 3 cm. Another place of compression described by Crotti, which occurs especially in adults, is the point situated between the innominate artery and the left common carotid. This compression is not confined to one ring of the trachea alone, but extends over a certain portion of it. This is easily understood when we consider the anatomical relations of the thymus to the trachea in that region. Since the thymus presses on the anterior surface of the trachea in the space between the left common carotid and the innominate artery, and since the trachea lies in front of the spinal column, then in cases of sudden enlargement the thymus, being itself compressed between the spinal column and the sternum, must exert a compression on the trachea.

Thymus death, or a sudden death, may occur without previous evidence of mechanical interference with the trachea. Crotti recalls instances occurring during nervous excitement, fright, before or during anesthesia, etc. The various explanations given are purely hypothetical. The fatal issue in some cases may be explained by the sudden swelling of the thymus due to some exertion, such as in crying, or to some interference with circulation. Possibly, in other cases the pressure over the base of the heart, and especially over the cardiac ganglia, may have caused a sudden inhibition of the cardiac system; possibly, too, in certain vulnerable individuals with a nervous system in constant unstable equilibrium, the shock from the peripheral origin as was experienced by falling into cold water, for instance, was such as totally to inhibit the central nervous system. Possibly, too, the laryngotracheal reflex caused by the first few inhalations of the anesthetic agent was powerful enough to inhibit an already unstable cardiac system.

Palancar and Arcaute⁷¹ conclude that certain cases of sudden death of thymic origin are caused by a toxic influence which is independent of any mechanical action. The microscopic examination of the thymus in one patient, who had been in previous good health, showed indications of intense functional activity and proliferation. The observers state that with hyperplasia of the thymus there may be perverted functioning,

⁷¹ Archivos Españoles de Pediatría, 1918, ii, 208, abstracted in Journal of the American Medical Association, 1918, lxxi, 690.

which may entail the gravest accidents. In their cases the lymphatic system seemed to be otherwise normal. This suggests that there is not the connection between the thymus and the lymphatic apparatus which some assume. Children have been born with hyperplasia of the thymus, but the writers know of no instance of congenital hyperplasia of the lymphatic system. Probably the mechanism is not always the same in the cases of sudden thymus death, toxic factors in some and mechanical factors intervening in others. Perverted functioning of the thymus is most common and most evident in infants under the age of sixteen months. The toxic action seems to be most injurious for the cardiovascular system. The microscopic findings in the case mentioned showed a remarkable number of subpericardial and subcapsular ecchymoses, one apparently in every terminal arteriole.

The relation of the thymus to the other endocrine glands has been shown, especially with regard to the thyroid. After thymectomy in animals the thyroids become manifestly lymphatic, and, conversely, after thyroidectomy the thymus undergoes hyperplasia. The importance of this fact is emphasized again by Crotti, since it will allow us to understand why after an operation for goitre we may have to deal with mechanical as well as functional disturbances due to an increased thymic hyperplasia.

Recently, Uhlenhuth⁷² has demonstrated an antagonism between the thymus and parathyroid glands in animals. He states that the thymus gland of mammals contains a substance which is capable of producing tetany when fed to the larvæ of certain species of salamanders. As long as the larvæ have not developed their own thymus glands, they are able, by means of some mechanism, to counterbalance the tetanic action of the thymus substance introduced in their food. When, however, the secretion from their own thymus glands is added to the thymus material introduced with the food, this mechanism of preventing tetany becomes inadequate and tetany ensues. If the thymus is the organ by whose action tetany is produced, Uhlenhuth says we can understand why tetany in human beings occurs far more frequently in children than in adults, since in the latter the thymus gland is replaced, at least to a great extent, by connective tissue. The relation of thymus to tetany may also possibly explain the occurrence of tetany during pregnancy; while the parathyroids of the mother may be sufficient to prevent tetany from her largely atrophied thymus, they may not be sufficient to prevent tetany from the excess of thymus substance furnished by the fetus to the blood of the mother.

The diagnosis of thymus hyperplasia is more certainly made by the x-rays than by any other means, although this procedure in adults is not without error, as in a case recorded by Crotti. The patient in whom, clinically, there were no evidences of thymic disease, the x-rays showed a thymic shadow, but autopsy revealed no thymic enlargement.

The treatment advocated by Crotti for thymic hyperplasia in children, if mechanical symptoms are alarming, is to operate at once. Crotti

⁷² Journal of Physiology, 1918, i, 23-33.

questions the risk of losing the patient by trying any other method of treatment, when the operative treatment is still safe. Two of his cases which had a marked thymus hyperplasia and in which the thymus compressed not only the trachea but also the esophagus, gained an ounce the same day that thymectomy was performed, and continued to do so for two weeks after; in three months the two little patients had become prosperous and healthy. Several others who had choking spells increasing constantly in intensity, so much so that when brought for operation they were between life and death, as soon as thymectomy was performed they soon breathed regularly and regained perfect health.

If, however, operation cannot be performed because of impending death, intratracheal rubber tubes should be introduced, either through the larynx or through a tracheotomy opening. It is important to make sure that the tube opens at the end and not on the side. It is important, too, to extend the tube well into the trachea so as to pass the point of compression. We must remember, however, that tracheotomy ought to be resorted to as a last measure, because we know by experience that tracheotomy combined with thymectomy is usually fatal on account of postoperative bronchopneumonia, and especially mediastinitis. If the choking spells are not alarming, x-ray treatment is the method of choice.

Suprarenals. Hyperadrenalism in association with hyperthyroidism has been described in an earlier paragraph of this review. The literature upon organic disease of these glands has been scarce during the past year. Osborne⁷³ has reported two cases of suprarenal disease. Their histories are unique, and deserve quotation because of their practical value.

CASE I.—A man, aged thirty-four years, was first seen on September 7, 1915. So far as he knew, he was well up to February, 1915, when he began to develop brown spots on his face and his whole skin began to darken. This pigmentation increased, spreading down to his neck, over his hands and somewhat over his body, so that at that date, namely, September 7, his face, neck, ears, hands and arms had become as black as the skin of an ordinary negro. The skin of the genitals and the surrounding region was absolutely black. He had a few jet-black pigmented spots on his thighs and some streaks on his back below the neck, with a little lighter (but still darker than normal) skin between these jet-black areas. The sides of his tongue were pigmented black; the top of the tongue was dark. The buccal mucous membrane and lips were black. In January, 1915, he had weighed 163 pounds; his weight at the date of this examination was 140 pounds. He said he was at times very weak and could hardly move around. His hands and feet became cold and he had to cover himself very warmly at night. He complained of sweating a great deal. Pulse, 96; systolic blood-pressure, 95 mm.; diastolic pressure, 90. The heart sounds were normal but very weak; the lungs were normal; liver somewhat enlarged; right kidney movable and slightly loosened; spleen somewhat enlarged. The urine was normal. The Wassermann test was reported negative and the blood reported normal. He was diagnosed

⁷³ American Journal of the Medical Sciences, 1918, clvi, 202.

suprarenal disease and a 3-grain suprarenal tablet given three times a day, and a pituitary tablet, each representing 1 grain of the whole gland, twice a day, the latter with the idea of stimulating suprarenal activity.

The patient was seen again on September 14, one week later. The pigmentation had very much diminished from the trunk, leaving only a few darkened areas; the same was true of the mucous membrane of the mouth. The face was not as dark and the insides of his hands were almost normal in color. The amount of urine had been increased. The systolic blood-pressure was 100 and the diastolic 70. The pulse was 84 and very weak. His weight had increased to 138 pounds. His appetite, however, had become poor, and he had a great deal of indigestion, with pain in his upper abdomen, general, not localized anywhere. This pain came on more especially at night and was worse on lying down. He had never had this before. He also had some palpitation of the heart at these times. With this pain his face flushed. He also was having some pain along the spine. The suprarenal tablets were reduced to two a day and the pituitary substance to one tablet a day.

This patient lived in New York, and the following week he wrote that his face, hands and body had lost a great deal of the pigmentation, but that he was so weak he could not travel. He was not heard from again until it was learned that he had died on October 19, and an autopsy showed that both suprarenal glands were completely destroyed with tuberculosis and that there were large desposits of calcareous substance in them.

This case is unusual because of the marked symptoms of insufficiency of the adrenal glands, as shown by the unusual amount of pigmentation and the exceedingly low blood-pressure. There was no history of fever. The lungs and other parts of the body were not involved in the tuberculous process. There were no digestive symptoms until the last few weeks of his life. He died from the extreme weakness of his heart and the low blood-pressure. The pulse-pressure was one of the shortest that Osborne has ever noted, the difference between the systolic and the diastolic being, at the first observation, only five points. Under suprarenal it temporarily increased to thirty points.

CASE II.—This patient is a married man, aged twenty-five years. He was first seen on June 28, 1917, with the history of having been well until May, 1917, when he began to vomit, associated with some cough. He had more or less continued fever, and an eruption of reddish spots on his skin, erythematous in type, this particularly on the feet, arms and elbows, on the flexor surfaces. He also had a great deal of pain in his feet and shoulders, and burning sensations and paresthesias of all kinds, and tinglings. These disturbances were sufficient to prevent sleep; these spots were not purpuric. There was no hemorrhage, although the gums bled slightly, and he had had several attacks of nose-bleed. His fever ranged about 100° and his pulse was about 100. He could eat practically nothing without vomiting; even water was vomited. He was too weak to stand on his feet. These erythematous and punctate spots disappeared, followed by a little desquamation in these regions, especially on the sides of the fingers and sides of the toes, but scarlet fever, although

considered, was decided not to have been present. From this time, namely, about the latter part of May, the discoloration began to increase and at this date, June 28, 1917, he was as dark as a colored person on many parts of the body, especially on his chest and abdomen, with a few white streaks mixed in with the dark pigmentation. His arms were dark; his face showed dark pigmented spots. At this time his cough had ceased and his vomiting was less frequent, but he was excessively weak and complained of numbness and tingling of his hands and feet from poor circulation. There were no edemas. The urine was negative. He had had very little pain in his abdomen except while vomiting.

The heart and lungs were normal. Systolic blood-pressure was 100 and diastolic pressure 60. No history and no signs, symptoms or stigmata of syphilis. He had some pigmented spots in his mouth. The liver was slightly enlarged and the spleen palpable; the rest of the abdomen was negative. His usual weight was 138 pounds; at this date it was 110 pounds. He had a mass of enlarged glands on the left side of his neck, which had been increasing in size. Examination of the blood showed nothing specially abnormal. A diagnosis of suprarenal disease, probably tuberculosis, was made. He was given a suprarenal tablet, three times a day, and iron.

In two weeks the pigmentations began to disappear, and instead of being black on his abdomen and arms, he was mottled. The glands of the side of his neck were smaller. There was no diarrhea; he could eat well and retain his food, but he felt very weak and continued some afternoon temperature. Blood-pressure, 98 mm. systolic and 70 diastolic.

Roentgen-ray investigations of his chest showed no tuberculosis of the lungs; he reacted positively to tuberculin, but there were developed no focal reactions in the lungs. He remained at the hospital for four weeks, gained twenty pounds in weight and under suprarenal treatment the pigmentation almost entirely disappeared. He was seen again on September 23, 1917, when the only pigmentation remaining was a small amount on the lower back and buttocks. He was running no temperature. The blood-pressure was 110 systolic and 80 diastolic. The tongue was clean; the liver and spleen seemed normal; the urine was negative; he was very weak and unsteady when he walked. The glands of the left side of the neck had broken down and now had formed an abscess. Suprarenal tablets were continued.

The patient has not been heard from since this last date, September 23. Osborne believes the prognosis to be bad in spite of the improvement. The amount of improvement is certainly unusual, especially as to gain in weight.

The case of adrenal disease is again one that is unusually marked by the pigmentation deposits and unusually interesting because of the disappearance of the pigmentation under suprarenal treatment. The loss of muscular strength in both these patients, due to suprarenal deficiency, was very marked. It cannot be entirely attributed to the low blood-pressure, and therefore poor circulation; it is in part, at least, due to muscle weakness.

SUPRARENAL HEMORRHAGE IN THE YOUNG. Fredericksen⁷⁴ reports a fatal case of hemorrhage into the suprarenals in a six months' old child. The suprarenals were not ruptured. He found other cases on the hospital records in an infant and a boy of fourteen years. He compiled 25 cases from the literature. Most of them were in nurslings, only 3 cases were between two and three years and only 1 in a child of fourteen years. The children were all apparently well nourished and seemed to be thriving. They woke suddenly toward morning, screaming, sometimes vomiting, sometimes with diarrhea, sometimes with convulsions, intense cyanosis and pallor; no sign of lung affection, but high temperature, small irregular pulse, and sometimes unconsciousness or great distress. The cyanosis extends around the trunk and on the extremities and nates, and in a few hours petechiæ develops and death follows in from six to twenty-four hours after the first symptoms, without any cause having been discovered until necropsy reveals hemorrhages in both suprarenals.

Examination of the blood in 12 cases revealed staphylococci, streptococci or pneumococci in only 7 cases. In none of the cases was the hemorrhage sufficient in amount to rupture the capsule. Death seems to have been due to the acute insufficiency of the suprarenals, and this suggests that epinephrin given in time might have warded off serious consequences. The cutting off of the natural epinephrin supply from the blood relaxes the tonus of the peripheral bloodvessels, and thus may explain the cyanosis and also the purpura in these cases. The absence of hemorrhages in other internal organs shows that a general hemorrhagic tendency does not exist. All the children died, but the occasional discovery of signs of old hemorrhage in one suprarenal at necropsy of children dying from other cause shows that this "suprarenal apoplexy" is not always inevitably fatal.

DISORDERS OF THE SPLEEN AND BLOOD

The Spleen. DISLOCATION OF THE SPLEEN into the pelvis and its firm fixation to the uterus is described by Saliba.⁷⁵ The rational treatment is splenopexy, but the dislocated spleen is rarely healthy, and, therefore, splenectomy is often indicated. Saliba did a splenopexy and the patient made a good recovery.

RUPTURE OF THE SPLEEN was discussed by Willis⁷⁶ before the Southern Surgical Association. He reports 4 cases which presented the following points in common: They were all male; there had been a blow on the left side of the body in the splenic region; secondary anemia and leukocytosis were present; there was no external evidence of injury about the body; there were rigidity and tenderness of the abdomen; all had shock following splenectomy; all the spleens were practically normal in size, with short pedicles and without any history of previous

⁷⁴ Ugesk. f. Laeger, Copenhagen, abstracted in Journal of the American Medical Association, 1918, lxx, 426.

⁷⁵ Surgery, Gynecology and Obstetrics, 1918, xxvii, 73.

⁷⁶ Journal of the American Medical Association, 1918, lxx, 341.

disease of the organ. Three of the 4 patients had agonizing pain in the left shoulder, which was promptly relieved by splenectomy. In 2 of the cases a marked increased leukocytosis persisted after the operation over a period of from two to four weeks. Three patients had a satisfactory convalescence. One died eight days after operation. The fatal case showed a continuous fall in hemoglobin and a decreasing leukocyte count. In the first 2 cases operation was followed by direct transfusion, with apparently good results.

Ochsner, in discussing Willis's report, stated that he believed a little spleen tissue is absolutely essential to life. It is possible that the difference in reaction to operation by patients and in animals may be explained by the presence of supernumerary spleens in the cases with favorable outcome.

Ganguli⁷⁷ reports an interesting case of splenic rupture in which death occurred twenty-five days after apparent recovery. After nineteen days' stay in the hospital all symptoms subsided and the patient was discharged. He was readmitted later, with sudden and severe pain, and died soon afterward. At autopsy the abdomen was found to contain two or three pints of blood and the spleen ruptured at the hilus. Ganguli believes that at the time of the injury the hemorrhage must have been within the spleen and on the day of death rupture into the abdominal cavity occurred. A recent history of fever led the author to believe that it was the cause of the splenic softening which favored rupture when the organ was traumatized.

TUBERCULOSIS OF THE SPLEEN, especially with regard to treatment, is considered by Petersen,⁷⁸ who insists on the necessity for removal of a tuberculous spleen at the earliest possible moment even if there may be tuberculous lesions elsewhere. The tuberculous spleen leads inevitably to death unless it is removed in time, while a complete cure is possible after splenectomy if no other organs are involved. He devotes eleven pages to tabulation of the details in 21 operative cases, including one from his own experience. The mortality was 25 per cent., but 60 per cent. were cured when last heard from. The findings are tabulated also from 23 cadavers, with tuberculosis of the spleen. The differential diagnosis is based on the chronic course, the personal and family history and the enlargement of the spleen, with little if any tenderness; but there are about a dozen other diseases that have to be excluded first, from leukemia, hemolytic jaundice, polycythemia and anemia to malaria, cysts and abscesses. The chief difficulty is in excluding pseudoleukemia and polycythemia. Banti's disease calls for splenectomy likewise. Even at the laparotomy, differentiation may be difficult.

MASSIVE INFARCTION OF THE SPLEEN was found at autopsy by D. S. Richey.⁷⁹ The patient died of pneumococcic meningitis secondary to an old otitis media and mastoiditis. At autopsy the spleen was atrophied and showed a large area of necrosis, fibrosis and calcification, and

⁷⁷ Indian Medical Gazette, 1917, lii, 399.

⁷⁸ Hospitalstidende, Copenhagen, 1918, lxi, 1073, abstracted in Journal of the American Medical Association, 1918, lxxi, 1868.

⁷⁹ Journal of Laboratory and Clinical Medicine, 1918, iii, 519.

two small peripheral masses of living splenic tissue surrounded by dense fibrous adhesions. This patient had a small spleen—most of the recorded instances of massive infarction occur in large spleens. Among the 28 cases reported by Nuzum, only 2 were small spleens, the others large, one weighing 2700 grams.

The Diagnosis of Infarction of the Entire Spleen has received but little attention in the past. Nuzum,⁸⁰ after reviewing the literature and studying 4 cases of his own, believes that it is possible to diagnose this condition antemortem. He states that the symptoms are pain, tenderness in the left hypochondrium, enlargement of the spleen, occasionally fever and vomiting of blood due to rupture of dilated gastric veins. A glance at the literature reveals the regularity with which these symptoms are recorded. The added examples in this report are a repetition of the former.

Whenever the spleen becomes totally infarcted, enlargement occurs, the weight varying from 300 to 1300 gm., and the dimensions reaching such proportions as 25 by 15 by 8 cm. The enlargement in all of the new cases reported here was noted on physical examination, but was often misleading, it being assumed that such an enlargement must be due to a leukemia or other condition. This fallacy is demonstrated by the fact that infarction of the spleen may result in a huge enlargement, such as occurred in no less than ten instances in this report. Pain in the left hypochondrium likewise is present, though variation in the site of the pain differs somewhat. In 3 cases the pain was described as diffuse throughout the abdomen, then localizing in the left hypochondrium, and in the fourth as "in the region of the stomach." The character of the pain varied from a dull ache to a sharp colic, with all degrees of gradation between. The pain is usually superficial and spontaneous, but may be deep and provokable. It is frequently exaggerated by changes in position, and may radiate along the phrenic nerve or into the left shoulder. A sensation of weight in the left hypochondrium was often complained of, a violent hauling to the left exaggerated by inspiration, or a tingling, shooting or beating sensation in the same region. The pain is probably due to irritation or interference with the structures immediately surrounding the spleen, since this organ is not very sensitive. Total infarction of the spleen may occur, however, without any pain, as in one case here reported and in three of those in the literature.

Tenderness is usually associated with the pain, and is present in the left hypochondrium. The tenderness may come on suddenly and may continue for many days, or there may be occasional tenderness in the left side.

The presence of fever apparently depends on the disease to which the spleen alterations are concomitant. When this is due to an obstruction of the splenic vessels by thrombi or emboli that are sterile, fever is absent. But, after the spleen has undergone degenerative changes, bacteria which were already present or which make their entrance from some source, such as the colon, multiply rapidly, the organ finally resembles

⁸⁰ Journal of the American Medical Association, 1918, lxx, 282.

a bag of pus, and fever occurs. In 1 of the 4 cases here reported, the *Proteus mirabilis*, in another the colon bacillus was isolated from the spleen, and in each instance a rise in temperature of from 1° to 2° was present intermittently. Many times the splenic changes result from or are accompanied by inflammatory changes elsewhere in the body, and under such conditions the fever is often attributable to such factors. In one of our instances a gangrenous cystitis, in another a suppurative pylephlebitis, and in a third an amebic dysentery was present and would account for the rise in temperature.

The vomiting of blood, bright red at times, and resembling coffee grounds at others, is of frequent occurrence. It was present in one of our instances and in several from the literature. Ewald recorded an example of a large spleen resulting from a thrombosed splenic vein, the patient dying as the result of a hemorrhage from the stomach. Following the hemorrhage there was a marked reduction in the size of the spleen. The reasons for bleeding from the stomach following splenic infarction or necrosis are well known and have been substantiated by experiments. The splenic changes are accompanied by extensive anastomoses between the splenic and gastro-epiploic vessels. The dilatation of these gastric veins often becomes extreme, and the possibility of their rupture is imminent. However, the bleeding in the instance recorded by Ewald was through a mucous membrane of the stomach which did not present gross lesions. This, too, has been described before.

Nuzum tabulates 28 cases of total infarction of the spleen from the literature with regard to the cause, symptoms and pathology. Total infarction may result from an embolus or a thrombus in either the splenic artery or the splenic vein; from the extension of a thrombus backward from the portal vein into the splenic vein; from pressure on the splenic vessels by a neoplasm; from torsion of the splenic vessels when the spleen is displaced, or from an inflammatory process originating within the spleen and involving the terminal branches of the splenic artery and vein (Bonne's view).

The *treatment*, according to Nuzum, whether medical or surgical, depends on many factors, such as the condition of the patient and the underlying disease of which the splenic infarction may be either the chief expression or only a minor part.

BANTI'S DISEASE. The above discussion of splenic thrombosis brings to mind the possible relationship between this condition and Banti's disease. Banti⁸¹ assumes that a toxic agent produced in the spleen brings about the changes in the splenic and portal vessels, finally the three stages of a typical Banti's syndrome resulting. The first stage includes an enlargement of the spleen; the second, urinary changes and marked anemia; the third, liver changes with ascites and a gradual increase in the severity of all the symptoms. The treatment of this condition is recognized by all writers as being clearly splenectomy. In the early stage, according to Balfour,⁸² the risk is not great and the prospect of permanent cure excellent. The ultimate effect of operation is excellent if it is

⁸¹ Folio Hæmat., 1910, x, 33.

⁸² Balfour: International Abstract of Surgery, January 1, 1918.

performed early. Fottner and Archibald⁸³ report the case of a girl, aged fourteen years, with splenomegaly, hepatic enlargement and leukopenia with intermittent fever. The condition was considered a splenic anemia allied to Banti's disease. Operation was performed and six months after splenectomy the patient was doing well—gaining in weight and strength. Blain⁸⁴ reports a case of Banti's disease in which ligation of the splenic artery was performed with beneficial results.

SPLENECTOMY continues to be practised for a wide variety of conditions associated with splenomegaly, in some instances with good results, in many instances with questionable indications. Hitzrot⁸⁵ summarizes what is known about the anatomy, physiology and clinical features of splenic disease, with special reference to the effect of splenectomy in normal animals and in pathological conditions, and Balfour⁸⁶ has written an excellent collective review of the "Surgery of the Spleen," containing a classification of the conditions for which splenectomy has been performed, together with a reference to 135 articles in the literature.

The removal of the spleen in a case of chronic septicemic endocarditis, in which the organ was markedly enlarged is reported by Reisman,⁸⁷ who, because his patient was so markedly improved after operation, hopes the procedure will be undertaken by others.

Fourteen splenectomies, with one death, is the record of Sherren,⁸⁸ who performed the operation in 9 cases of splenic anemia and Banti's disease, 1 of Gaucher's splenomegaly, 1 of hydatid cyst and 2 of splenomegalic jaundice. The death occurred in a boy, aged fourteen years, who had, in addition, advanced cirrhosis of the liver.

THE TREATMENT OF SPLENOMEGALY WITH ANEMIA IN SYPHILITICS is considered by Eason,⁸⁹ who reports a case in which the Wassermann test remained positive after antisypilitic treatment had produced definite improvement. The possibility of surgical treatment is considered. Eason believes, with regard to the management of such cases of syphilitic origin simulating Banti's complex, that all cases should have very thorough antisypilitic treatment. No great harm and much improvement may result from this when carried out with care while watching the effect of each injection on the blood. If this has been done and the Wassermann test still remains positive, operation then becomes almost as necessary as for cases of the orthodox Banti type. The need for operation would not be quite so urgent if from time to time renewed specific treatment were known to rearrest activity. As this prospect is meantime based solely on hypothesis, the indication for operation is practically the same as in Banti's disease, if specific treatment has already failed.

Disorders of the Blood. THE BLOOD VOLUME AND SHOCK. The most important factor in the shock which follows severe injury or surgical

⁸³ Lancet, 1918, cxciv, 101.

⁸⁴ Surgery, Gynecology and Obstetrics, 1918, xxvi, 660.

⁸⁵ Annals of Surgery, 1918, lxxvii, 540.

⁸⁶ International Abstract of Surgery, January 1, 1918.

⁸⁷ Journal of the American Medical Association, 1918, lxi, 10.

⁸⁸ Annals of Surgery, 1918, lxxviii, 379.

⁸⁹ Edinburgh Medical Journal, 1918, xxi, 258.

operations is not exhaustion of nerve centers, suprarenal deficiency, inefficient cardiac contraction, acidosis or lack of vasomotor tone, although any one of these factors may play its part, but rather the small amount of fluid in effective circulation. At a recent meeting of the Royal Society of Medicine, Bayliss⁹⁰ stated that it has gradually come to be realized that the chief, if not the only really important, factor in shock is a deficiency in the volume of blood in circulation. Bayliss states that, apart from the fact that the general symptoms of hemorrhage and shock are very similar, estimations by the "vital red" method of the volume of blood in circulation have shown that it is decreased in both cases. The name "exemia" has been proposed by Cannon for the general condition. It is clear that blood must be accumulated or held up somewhere or other in dilated regions of the vascular system. Observations made in the course of abdominal operations give no support to the view that there is any significant degree of dilatation of the arteries or veins of the splanchnic area. The region in question must therefore be that of the capillaries.

But what is it that brings about such a dilatation of the capillaries? At an early date in the discussion of the problem it was pointed out by Major-General Cuthbert Wallace that operations involving injury of large masses of muscular tissue were specially liable to produce shock. Experiments by Cannon and Bayliss in the beginning of last year showed that crushing the thigh muscles of cats was followed by a progressive fall of blood-pressure and other signs of shock. They found that section of the spinal cord above the origin of the limb nerves did not prevent the result, whereas clamping of the artery and vein did do so. Some chemical product of the tissue injury must then be the responsible agent. This view was confirmed, more especially by McNee's observations on wounded men in a state of shock, when it was found that excision of the injured parts, or even preventing, by a tourniquet, blood passing through it from entering the general circulation, was followed by marked improvement. They thought at first that the toxic agent might be lactic acid, but experiment showed injection of this or other acid to be innocuous. In fact, "acidosis" turned out to be a negligible factor in the causation of shock. It is the result, not the cause, of the low blood-pressure. The real agent is a much more toxic one. Dale and Laidlaw have described the action of a base, histamine, which has the remarkable effect of powerfully dilating the capillaries, but not the arterioles, and which in larger doses produces a condition of profound shock. There is reason for believing that substances of this kind are produced in injured and disintegrating tissues. It was found, further, that massage of the injured muscles in the experiments on cats resulted in accelerated fall of blood-pressure, so that we have an experimental justification for keeping injured parts as immobile as possible, as is done by the Thomas splint in the case of fractured femur. These injurious effects are, of course, intensified by causes tending to depress the circulation, such as cold, anxiety, fatigue, thirst, hemorrhage and so on.

⁹⁰ *Lancet*, 1919, cxevi, 256.

The Treatment of Reduced Blood Volume. The indications for the treatment of shock seem obvious. The volume of the blood in the circulation must be increased. Mohler, who has been with the Jefferson Base Hospital No. 38 overseas, has described for me the practice generally followed by our physicians with the Expeditionary Forces during the past year:

Patients suffering from shock in which immediate operation was necessary were rapidly reacted by blood transfusion. If, in a patient with shock not due to hemorrhage, the systolic pressure fell below 80 mm. Hg., or if, in the case of hemorrhage, it fell below 90 mm. Hg., blood transfusion was performed to raise the blood-pressure before operative procedures were attempted. The method of matching the blood transfusion is herewith briefly described.

Among human beings it is definitely known that all individuals fall into one of four groups and that the percentage distribution of these groups, based on the results of matching the bloods of several thousand individuals by several different workers is as follows: Group I, 5 per cent.; Group II, 40 per cent.; Group III, 10 per cent.; Group IV, 45 per cent. There was supplied from the Central Medical Department Laboratory of the American Expeditionary Forces serum prepared for making these group determinations. The sera were labelled Group II and Group III. The method is a microscopic slide test. The procedure is as follows:

Take a clean, dry glass slide, mark with a wax pencil "II" on the upper left-hand corner and "III" on the upper right-hand corner. Place a drop of Group II serum and a drop of Group III serum on the respective ends of the glass slide. A puncture is made into an ear lobe of the individual to be grouped. Take a drop of blood, about half the quantity of the drop of serum placed on the slide, and mix it thoroughly with one of the sera. Do likewise with another drop of blood in the other drop of serum. A clean glass rod should be used for each sera to prevent possible false reactions.

Within a few seconds after mixing the blood and serum one may see in one or both sera a brick-dust-like appearance, or one may see only a homogenous suspension of cells in one or both sera. The brick-dust-like appearance denotes agglutination. Groups are indicated as follows:

When agglutination occurs in both sera the individual belongs to Group I.

When agglutination occurs *only* in III serum the individual belongs to Group II.

When agglutination occurs *only* in II serum the individual belongs to Group III.

When *no* agglutination occurs in *either* sera the individual belongs to Group IV.

A number of possible donors may be grouped and a record kept of their names and groups. When a transfusion is required the recipient can be grouped and a donor selected from the list on record. One should use a donor of the *same* group to which the recipient belongs. When this

is not possible a Group IV may be used for anybody, *but it is better to use the same group.*

Avoid mixing too much blood with the serum, as it obscures a clear-cut result.

After the proper donor was chosen, the amount of blood was obtained by plunging a needle into a vein in the arm. The needle was connected by a rubber tubing, which in turn was attached to one of two glass tubes which passed through a rubber stopper into a graduated 750 c.c. bottle containing citrate of soda solution. To the other glass tube was attached a rubber bulb which was used to create in the bottle a partial vacuum, thereby facilitating the collection of blood. The blood is allowed to flow into a vein in the forearm of the recipient by gravity.

Bayliss, in discussing the treatment of shock before the Royal Society of Medicine, states that while transfusion of blood itself is the natural means, it is clear that if a satisfactory substitute in the form of an artificial solution, could be made, it would frequently be of value. No simple saline solution, whether iso- or hypertonic, or containing sodium bicarbonate or calcium salt, has any permanent effect. The liquid introduced does not remain in the bloodvessels for more than half an hour or so. To ensure that it shall not leave the circulation, the addition of a colloid is necessary. The function of this is to attract water by its osmotic pressure and so to counteract the filtration produced by the blood-pressure. Of those colloids admissible, gum arabic is, on the whole, the most satisfactory. To correspond with the proteins of the blood plasma, a 6 or 7 per cent. solution in 0.9 per cent. sodium chloride is correct. Such a solution has been found in practice to serve as well as one containing bicarbonate or excess of calcium. The use of vaso-constrictor drugs is to be deprecated. It has been found that the reserve of hemoglobin is sufficiently great for recovery to take place even when it is reduced to a quarter of its normal value. Hence, it would seem that gum-saline should be effective in the majority of cases. A reduction of hemoglobin to the extent mentioned implies a loss of blood of nearly 4 liters in man. It has not yet been possible to state definitely what are the clinical signs showing the necessity for blood transfusion, apart from actual determinations of the blood volume and hemoglobin percentage. Some surgeons state that no case failing to react to gum is amenable to blood. If, however, the delay between injury and treatment has been great, no measures avail. The tissues, especially those of the nerve centers, as shown by F. W. Mott, become so far damaged by the low blood-pressure and want of oxygen that recovery is impossible.

In actual practice the following general procedure may be recommended: If the patient is cold and fatigued by a long journey, try first the ordinary measures of resuscitation, such as warmth, water to drink and rest. If little or no improvement in half an hour or so, 750 c.c. of warmed gum-saline slowly into a vein. This may probably be insufficient in amount. Therefore, if some benefit in half an hour, more gum-saline. If no result at all from the first injection, transfusion of blood if available. But the evidence of the whole suggests that if gum-saline is ineffective, blood will be also useless, except in the rare cases

in which the loss of blood has been more than 75 per cent. of the total volume.

Walker⁹¹ found that critical cases made a dramatic recovery from their shock when transfused with bicarbonate after blood. He did not think either blood or bicarbonate alone could have produced the same effect. After the use of these fluids the general results showed a steady improvement.

Pemberton⁹² reports a series of 1036 blood transfusions, summarizing the general indication, dangers and results of the procedure as performed on 429 patients during three years ending January 1, 1918, at the Mayo Clinic. Five were done by means of the paraffin-lined cylinder, 30 by a modified cannula-syringe technic, and the others, 1001, by the citrate method. Pemberton states that the definite effects of transfused blood are: (1) Restoration of the bulk of the circulating fluid, (2) provision of oxygen and assimilable pabulum for tissues, (3) increase of the coagulability, (4) stimulation of the hematopoietic organs, and (5) increase of resistance to infection by its antitoxic and bactericidal properties.

Reactions to Blood Transfusion. Pemberton⁹³ reports reactions in 219, or 21 per cent., of transfusions of the above series. There occurred from fifteen minutes to one hour later, a slight reaction of chill and fever, a temperature of 100° to 105°, with or without malaise, headache, nausea and vomiting and diarrhea, and followed, in a small percentage of cases, on the third day after the transfusion, by an eruption of herpes. In another 15 per cent. of transfusions there occurred a rise of temperature to 100° or above, not associated with chill and nausea. These were, in every instance, of a transitory nature, the temperature returning to normal in from twelve to thirty-six hours, and in only two instances was it at all probable that the good of the transfusion was vitiated by this complication.

Pemberton states that the nature of such reactions is unknown. Various theories have been suggested, for example: (1) The introduction of a foreign protein, (2) the introduction of a citrate solution, (3) incipient coagulative changes in the transfused blood, (4) slight degree of hemolytic changes occurring after transfusion not sufficient to be evidenced by clinical test, and (5) incompatibility of the white corpuscles of the donor and recipient. All may be factors, but in this series there was a striking relationship between the pathological condition for which the transfusion was indicated and the occurrence of these milder reactions. A decidedly higher disproportion in the percentage was seen in those cases, such as pernicious anemia and advanced malignancy, in which there were active hemolytic changes. In some of these, the intravenous introduction of normal saline alone was followed by similar reactions.

Lewisohn⁹⁴ reports the clinical results of 200 transfusions of citrated blood. The author states that experiments on animals and clinical

⁹¹ Lancet, 1919, cxcvi, 258.

⁹² Surgery, Gynecology and Obstetrics, 1919, xxviii, 262.

⁹⁴ American Journal of the Medical Sciences, 1919, clvii, 253.

⁹³ Ibid.

experience have proved beyond doubt the efficiency and harmlessness of this method. According to the experience of this author and of others, chills occur somewhat more frequently with the citrate method than with other methods of blood transfusions. In his series of 200 transfusions, he encountered chills in 40 cases (20 per cent.). The reasons for these chills, if proper blood tests were made before the transfusion, are not quite clear. The author has repeatedly seen that in the same person citrate transfusions did not cause any chills, whereas subsequent transfusions of non-citrated blood caused acute rise of temperature with chills, and *vice versa*.

It is interesting to note that in the first 22 transfusions of his series no chill occurred. Furthermore, he has never observed a chill following transfusion given to children, even when rather large amounts of blood, as compared to the body weight, were introduced. No chill was encountered in any of those cases in which transfusion was given following a profuse hemorrhage.

It is by no means impossible that future investigators may find another anticoagulant which may possibly diminish the percentage of chills. However, it is safe to say that the principle of the method (application of an anticoagulant for the simplification of the technic of blood transfusion) will prove of permanent value. The application of this principle has transformed transfusion from a very cumbersome and difficult method into a most simple procedure. Blood transfusion at the present time is not any more in the hands of a few specialists, but within the reach of every practitioner. By the immediate application of this simple method of blood transfusion in emergency cases a great many lives can be saved, especially in small communities, where the performance of the older, more complicated methods was out of question.

THE BLOOD IN TRINITROTOLUENE POISONING. This substance during the past few years has taken its place among the important industrial poisons. The sickness which is produced varies in type, according to Pantou, and may be (1) severe gastric disturbance without jaundice or anemia; (2) anemia of the aplastic type, and (3) toxic jaundice. The jaundiced patients may acquire aplastic anemia also. The subject of T. N. T. poisoning, as it is briefly called, was discussed at length in last year's *PROGRESSIVE MEDICINE*. L. H. Smith,⁹⁵ during the past year, reported the results of the blood examination of 25 men who were employed where T. N. T., in its fully powdered form, was used in the filling of shells. These men had been working in the same room at various tasks from foreman to that of janitor. The air of this room was more or less constantly filled with trinitrotoluene dust. All the men were at work at the time of examination. A majority of the men had been at work for five months or longer.

Nine of the workers were sick at the time of the examination, but a few had slight blueness of the lips, and several admitted having abdominal pains, "full feeling" in the epigastrium, constipation, and two or three had had skin rashes. Nearly all experienced the bitter taste, which

⁹⁵ *Journal of the American Medical Association*, 1918, lxx, 231.

they counteracted by chewing tobacco. A few had an irritative cough, lacrimation and smarting of the eyes. Many wore hats to keep their hair from turning to the characteristic orange-yellow color. No case of jaundice or of anemia was noted.

There can be no doubt that there was ample opportunity for the absorption of trinitrotoluene through the skin and by way of the respiratory tract.

The blood findings in the 25 men examined were for the most part negative. So far as the red blood cells and the hemoglobin were concerned, no such changes were found as noted by Malden among the dinitrobenzene workers. This, on the whole, agrees with the work of Panton, reported last year.

The hemoglobin, the red blood cells and the white blood cells were not markedly affected.

No poikilocytosis, anisocytosis, basophilic granulations or nucleated red blood cells were observed.

The white blood cells, in a large percentage of cases, were somewhat above normal in number.

The differential counts showed some variation from the normal, the polymorphonuclear neutrophiles being increased in many instances, and the eosinophilic cells slightly increased in about 40 per cent. of the cases. The platelets appeared normal.

BLOOD IN GAS-POISONING. An interesting translation of a German document labelled "For Official Use Only," and purporting to contain "Instructions Regarding the Diagnosis and Treatment of Gas-poisoning from the Standpoint of January, 1918," was issued to our medical officers in July, 1918, with a preface stating that it would be useful in conjunction with our information in the understanding of gas-poisoning. Gas-poisoning occurring in warfare may be caused by (1) explosive gases and (2) warfare gases. Poisoning by explosive gases is principally carbon monoxide (up to 60 per cent.), and the symptoms correspond to the well-known descriptions of carbon-monoxide poisoning. When the poisoning has reached its maximum, carbon monoxide can frequently be detected spectroscopically or chemically. A hand spectroscope is used, although the chemical tests are more sensitive. The following example is given:

Solutions, diluted to the same depth of color, of the normal blood and of the blood to be tested are placed respectively in two test-tubes (a drop or two of blood from the fingers), and the same number of drops (3 to 5) of copper sulphate solution are added to each. The normal blood rapidly turns to dirty greenish yellow, the carbon-monoxide blood retains its red color for a longer time. The difference in tint vanishes after a few minutes.

In the *treatment*, the inhalation of pure oxygen is advised to drive the carbon monoxide out of its combination with the hemoglobin of the blood and thereby hasten recovery. Oxygen inhalation must therefore be used in all cases which show definite symptoms of poisoning. The inhalation must be continuous. The mask of the oxygen apparatus must be so adjusted to the face as to form an air-tight joint, thus ensuring that, as far as possible, only pure oxygen is inhaled.

It is stated that during slow combustion of high explosives considerable quantities of nitrous fumes (nitric oxide, nitrogen peroxide, nitrous and nitric acid) are formed in addition to the carbon monoxide. The symptoms are those of the warfare gases described below.

The other poisonous gases (methane, acetylene, hydrocyanic acid, etc.), which are formed during the decomposition of explosives, do not attain a sufficient concentration to become of practical importance. The small quantities of undecomposed explosive (picric acid, nitroglycerine, etc.), which may be disseminated in the air, are of equally small importance as causes of severe poisoning in practice.

The warfare gases are included under three headings: (1) Gases other than yellow cross and hydrocyanic acid; (2) yellow cross substance; (3) hydrocyanic acid. The first group causes substantially the same effects—irritation of respiratory tract and special changes in tissues of lungs. The blood changes are described as follows: Immediate destruction of the blood or the formation of poisonous products in the blood does not usually occur. No change in the hemoglobin has been recognized in animal experiments or in the case of man. No methemoglobin and no carbon monoxide hemoglobin are formed. The oxygen capacity of the hemoglobin is not altered. Moreover, there is no material acidification of the blood, even in fatal cases (apart from cases of very severe poisoning with concentrated gas). This is clear because the carbonic acid content of the arterial and venous blood is not lowered in any cases, but is either normal or even raised. Finally, blood that has been treated with many times the lethal dose of a poisonous gas has been found to be absolutely harmless on transfusion into a normal animal.

In contrast to the absence of direct damage, the indirect effects are often very pronounced in the case of the blood. They consist (1) of a marked concentration of the blood, and (2) of an alteration in the blood gases.

(a) The concentration of the blood is caused by the marked exudation of plasma from the blood into the lungs, which has been already mentioned, for this is not replaced, or at all events not quickly enough, by the passage of fluid from the tissues. The relative number of red blood corpuscles therefore increases, and the hemoglobin content increases correspondingly.

Since, at the height of the illness, more than half the blood plasma may leave the circulatory system and pass into the lungs, an increase in the number of red cells to over nine million may be found, and a rise in the hemoglobin content from 14 per cent. to 25 per cent. (over 140 on the Sahli scale). As the pulmonary edema is reabsorbed, these changes diminish and usually disappear after five to seven days. During this process there is no destruction of the red blood corpuscles. The increase and decrease of the exudate into the lungs may be followed clinically by frequent estimations of the hemoglobin.

The concentration of the blood is further rendered obvious by the increase in the viscosity (internal friction); this may be very great. In such cases the blood becomes of a tarry character. The viscosity

coefficient may rise from four to over nine. This depends mainly on the increase in the number of red blood corpuscles. At the same time other factors, such as an increased carbonic acid content, may play a subordinate part. In addition, the coagulation rate of the blood is increased, except during the first few hours after poisoning.

The increased viscosity and the rapid clotting of the blood are responsible for the fact that the red blood corpuscles in the cadaver do not sink, and that, in consequence, there is no differentiation into crur and buffy coat in the blood clots, especially in the heart. For the same reason, the large arteries are not found free from blood in the cadaver.

(b) The composition of the blood gases resembles that found in asphyxial blood, *i. e.*, there is less oxygen;⁹⁶ and more carbonic acid in the blood than is normally the case. The diminution in the oxygen content of the arterial blood is readily recognizable from the degree of cyanosis.

Moreover, the difference between the oxygen content and the carbonic acid content of the arterial and those of the venous blood is abnormally great. This is the result of the slowing of the circulation of the blood through the capillaries, while the capacity of the tissues to absorb oxygen remains normal. The slowing of the circulation depends in part on the increased viscosity of the blood.

The *treatment* is discussed at length, and the best remedy for the blood concentration is *venesection*. To be efficacious, the amount of blood withdrawn must be considerable: 350 c.c. must be taken as the lowest figure, but it is best to take 400 to 500 c.c., and even 750 c.c. has been abstracted with good results. Besides the diminution of the viscosity of the blood, the edema of the lungs is beneficially influenced and the circulation relieved. Patients often say that they feel relief immediately after the venesection. Respiration, pulse and consciousness often show a striking improvement. The good results are frequently permanent. It is often impossible to obtain the required quantity of blood from the veins at the height of the illness, when the blood is thick and tarry. For this reason it is advisable to perform venesection at an earlier stage. The effect of the venesection may be assisted by a subsequent intravenous infusion of physiological salt solution. A good result appears to have been obtained in individual cases. The danger that an increase in the supply of fluid may lead to an accentuation of the pulmonary edema need not be estimated too highly. Against it is the fact that occasionally it leads to serious overloading of the venous system and of the right heart. In addition the results are only transitory, since the infused fluid escapes into the tissues after a few hours. The applicability of saline infusion is therefore not so universal as that of venesection.

The YELLOW CROSS substance is "*Mustard Gas*," "*Yperite*" or *Dichlor-ethyl-sulphide*. It is an almost odorless liquid which evaporates slowly, clings to the garments, like petroleum, for instance, penetrates

⁹⁶ In the case of moderate or severe dyspnea in animals the arterial blood is only 75 per cent. to 66 per cent. saturated with oxygen, instead of almost completely. The carbonic acid content is normal during moderate dyspnea, but is raised at the height of the illness and shortly before death.

them, and may be conveyed to other clothing by contact. A certain time elapses before symptoms are noticed and the effects show themselves principally on the skin, eyes, mucous membrane of upper respiratory tract and lungs. The observations which have been made on the blood show variations in the composition of the blood. The number of red blood corpuscles apparently increases during the first few days of the illness, without simultaneous increase of the hemoglobin, while numerous crenated forms appear at the same time. Later on, slight anemia is likely to appear. The white corpuscles also show variations, without obeying any definite rule.

HYDROCYANIC ACID GAS-POISONING produces symptoms resembling in many respects those caused by carbon monoxide. The symptoms appear quickly and recovery is remarkably rapid. Hydrocyanic acid paralyzes the activity of ferments and consequently prevents the tissues from making use of the oxygen of the arterial blood for the oxidative processes. Hence, the oxygen-content of the venous blood is found to be increased. The tissues are asphyxiated in spite of the fact that a copious supply of oxygen is carried to them in the blood. In the case of the poisoning of man, there is no change in the hemoglobin.

The *treatment* consists in removing the case as quickly as possible from the neighborhood of the poisonous gas, and, if the breathing has stopped, in artificial respiration. As it will usually not be possible rapidly to make the differential diagnosis from carbon-monoxide poisoning, it is recommended to treat the case of hydrocyanic poisoning as if it were a case of CO poisoning, *i. e.*, to administer oxygen, and, if necessary, to employ artificial respiration while using the oxygen apparatus.

Recovery takes place, as a rule, in a short time. If a patient survives for an hour after the poisoning, he is usually unlikely to die.

HEMOPHILIA. Lowenberg and Rubenstone⁹⁷ report experimental data bearing on the effect of extracts of visceral hemophilic tissue on the coagulation of the blood. The tissues were secured at autopsy on a lad of six years, who had a typical family history and clinical manifestations of hemophilia. The method of Howell was followed and it was found that the extracts of the hemophilia tissues, excepting the thyroid and liver, have the same general effect on coagulation as normal tissues exert. Lowenberg and Rubenstone believe that these results signify that it is possible that the thyroid, and even the liver, may secrete an antithrombic substance or enzyme which may be in part, if not principally, the cause of the deranged coagulative mechanism of hemophilic blood.

THE ACTION OF THE ROENTGEN RAY AND BENZENE ON THE BLOOD. The experiments and clinical observations of the past have brought forth some interesting facts regarding the resistance of the red and white corpuscles to these agents. The observations of Heinecke and of Selling, as recently pointed out by Hurwitz and Falconer⁹⁸ show that the roentgen rays exert a selective action on the lymphocytes, and that even prolonged irradiation will not bring about any noteworthy changes either in the number of red blood corpuscles or in the percentage of

⁹⁷ Journal of the American Medical Association, 1918, lxxi, 1196.

⁹⁸ *Ibid.*, lxx, 1143.

hemoglobin. Benzene, on the contrary, has a somewhat different action. This drug has been shown by Selling to act destructively first on the white cells and more especially on the non-granular elements, and later to cause a diminution in the number of erythrocytes. The experimental studies have shown, however, that in order to effect any striking anemia, the drug must be administered in large doses and over a long period of time.

In view of the foregoing, it is of interest to note that Hurwitz and Falconer report a case of *polycythemia vera* in which treatment by the combined use of the roentgen ray and benzene was attended with beneficial results. The patient, a female, aged thirty-eight years, came under observation in April, 1915, complaining of nervousness and dizziness. About three or four years before she was first seen, she had had a sudden attack of dizziness lasting only a few minutes, followed by occasional headaches, and in April, 1915, she had been suddenly seized with an attack of blindness, lasting fifteen to twenty minutes.

It was after this last attack that it was noted that she had considerable cyanosis of the face, gums, arms and hands. On May 18, 1915, a blood count was made which showed a hemoglobin percentage of 105, 12,400,000 red blood corpuscles and 9000 white blood corpuscles. A diagnosis of *polycythemia vera* was made and the patient entered a hospital for treatment. This consisted of a milk diet, frequent intramuscular injections of an arsenical preparation and venesection. For a period of more than a year, from June, 1915, to August, 1916, venesection was the principal mode of treatment, and she remained comparatively free from subjective symptoms during this period.

In July, 1916, the patient came under their care first. She was found to be well developed and very well nourished, with a dark red face, cyanotic cheeks, and with lips and gums also of a somewhat brick red, cyanotic hue. The pupils were dilated, showed a regular outline, and reacted to light and direction. The fundi showed no abnormalities. The teeth were in good condition and the tongue was dark red. The thyroid was not increased in size, and there was no general glandular enlargement. Both heart and lungs were normal. The abdomen was full, rounded and symmetrical. The spleen could be palpated about a handbreadth below the costal border; the edge was rounded, smooth and slightly tender. The edge of the liver could not be felt, nor were the kidneys palpable. Both upper and lower extremities showed a marked grade of cyanosis. All the reflexes were normal. The Wassermann reaction of the blood serum was negative. The urine was of a dark amber, its specific gravity was 1020, and neither albumin nor sugar was present. No casts were found. An occasional red blood corpuscle and a few white blood cells were present.

A venesection was done July 20 and 500 c.c. of blood were removed. The patient was given iodides for a week. August 2, roentgen-ray treatment was begun.

October 9, 1916, she was admitted to the University of California Hospital, where she remained for two weeks. The general findings on physical examination were for the most part the same. During her stay

in the hospital, the patient took 33 gm. of benzene in one week. This was administered in capsules with equal parts of olive oil. A little less than 5 gm. per day were given. The patient complained of no untoward gastric symptoms from the drug.

After her discharge from the hospital, she took 8.5 gm. of benzene from November 10 to 18, when administration of the drug had to be discontinued on account of a burning sensation in the stomach, with regurgitation and belching. A further attempt to continue the drug was made from November 23 to 28, when the patient ingested 3 additional grams of benzene. The drug now had to be stopped permanently on account of nausea, gastric discomfort and headaches.

The other form of treatment from September to November consisted of two roentgen-ray exposures over the spleen, one of 25 ma. minutes and the second of 30 ma. minutes. These were continued in December and January, five additional exposures of the spleen having been made during this interval.

The patient was observed at frequent intervals until May, 1917. By the end of January, 1917, the blood picture showed a complete return to normal, the red count being 5,200,000 and the white blood corpuscles 9200 with a hemoglobin percentage of 98. The patient's subjective symptoms had entirely disappeared, and the objective signs of the disease were decidedly less pronounced. The skin and mucous membranes were still somewhat suffused, but they were definitely less bluish, whereas the cyanosis and the lividness of the extremities had entirely disappeared. At this time the spleen had completely receded, and could no longer be palpated. When last seen in February, 1918, the patient was continuing well.

THE ACTION OF RADIUM ON THE HEMATOPOIETIC SYSTEM has been studied by Millet and Mueller.⁹⁹ They found that the immediate effects of radium on the blood are the following: (a) An immediate drop in total white count, reaching its maximum from one-half to six hours after the application. (b) A return of the total white count to its formal level within twenty-four hours after the application, usually within the first twelve hours. (c) An occasional secondary rise of the total white count to a point well above its original level from twelve hours to three days after the application. (d) A close adherence of the total polymorphonuclear count to the curve of the total white count. (e) An absence of characteristic changes in the total lymphocyte and total large mononuclear counts. (f) A tendency of the total lymphocyte count to follow in some degree the fluctuations of the total white count, especially when these are marked. This effect is not constant. (g) A tendency of the relative lymphocyte count to drop and of the polymorphonuclears to rise during the course of treatment. This tendency is reversed during the period immediately following the removal of the radium.

Remote effects of radium treatment on the blood are as follows: (a) Early: (1) Fall in lymphocyte count from two to four weeks after treat-

⁹⁹ Journal of Cancer Research, 1918, iii, 127.

ment, sometimes lasting until the end of the second month; (2) fall in polymorphonuclears after treatment, sometimes simultaneous with the fall in lymphocytes but usually coming later and being less striking; (3) an attempt of the lymphocytes to recuperate, as shown by a rise in most cases at some later date, varying from three to nineteen weeks after treatment, to the approximate level seen before treatment. (b) Late: (1) Change in the relative counts as the patient's resistance weakens, with increase in polymorphonuclears and decrease of lymphocytes, but without leukocytosis; (2) terminal leukocytosis, due in the main to increase of the absolute polymorphonuclear count, although usually accompanied by an absolute decrease in lymphocytes.

PERNICIOUS ANEMIA. Linderman¹⁰⁰ states that the blood counts in pernicious anemia give an inaccurate estimate of the blood volume, and that the blood volume is always reduced. If the reduction in volume is only slight, the symptoms other than those referred to the nervous system, even though the degree of anemia may be severe, are relatively fewer and milder, and are borne with less distress. As the volume of blood is reduced, the symptoms of the disease increase proportionally. It is imperative, therefore, that to give proper treatment, an effort should be made to increase the bulk. The two ways in which this is best accomplished are by (1) an abundant fluid diet, preferably 2 quarts of milk a day, and (2) blood transfusion.

Diarrhea should be avoided because it reduces blood volume. Should it occur it should be regarded seriously and relieved promptly.

In Linderman's series of patients with pernicious anemia the blood volume varied from 1600 to 4200 c.c., or from 2.4 to 5 per cent. of the body weight. Those with the lowest figures are not ambulatory patients, and they suffer greatly with the disease. The patients with the higher figures, except in Case 9, could go about their homes and attend to their personal wants, and were in relatively better condition.

The normal blood volume in man, according to Keith, Rowntree and Geraghty, is 9 per cent. According to Haldane and Smith it is about 5 per cent. From Linderman's studies on donors when large quantities of blood have been drawn for transfusion, he is inclined to believe that the former workers are more nearly correct.

One should guard against extravagant claim as to curing the disease, because of its tendency to recur even after many years. Recently, Linderman was consulted in a case that had recurred after seventeen years.

Lewisohn,¹⁰¹ in discussing the results obtained in pernicious anemia, states that long intermissions of comparatively good state of health can be obtained by repeated transfusions. Such transfusions, however, can be considered a temperizing measure and not a curative one. The results obtained by blood transfusion in the early stages of the disease are often very promising and the intervals between remissions of rather long duration. However, the intervals get shorter and shorter, with the progress of the disease, and the efficiency of blood transfusion, even

¹⁰⁰ Journal of the American Medical Association, 1918, lxx, 1296.

¹⁰¹ American Journal of the Medical Sciences, 1919, clvii, 253.

when resorted to frequently, decreases rapidly, while the disease runs its fatal course. Splenectomy has been of benefit in a few single instances only. The vast majority of cases succumb in the course of two years (and often in a much shorter period) in spite of transfusions or splenectomy.

Pemberton,¹⁰² in discussing blood transfusion in pernicious anemia, reporting 657 transfusions in 185 cases, comes to practically the same conclusion, namely, "that the greater number of patients, except those who have reached the very last stages of the disease, will receive immediate benefit from the transfusion of blood. Many also who are *in extremis*, and who are not benefited by medical treatment alone, will show great improvement by a series of blood transfusions." He reports one case of unusual interest, and I am quoting it because it shows (1) the value of transfusions following splenectomy, and (2) the ability to transfuse a patient with four groups of donors without any evidence of hemolysis.

A male, aged thirty-six years, was admitted for examination February 10, 1915, with a history of good health until about one year previous to admission, when weakness, shortness of breath and increasing pallor gradually developed. From the history, examination and blood findings, a diagnosis of pernicious anemia was made. At this time his hemoglobin was 20 per cent., red blood cells, 1,730,000, with the presence of normoblasts and megaloblasts. Splenectomy was performed March 10, 1915, and April 7, 1915; before his dismissal, the hemoglobin was 70 and the red cells 3,640,000. Following acute tonsillitis in the fall he began to run down, and on December 1, 1915, he returned with hemoglobin 20 and red blood cells 1,190,000. From then until May, 1918, he had thirty-five transfusions of 500 to 750 c.c. each. His response to the transfusions has been remarkable. Ordinarily, two to four transfusions at weekly intervals are required to effect a definite remission in the course of the disease. His condition now is apparently as good as it was two years previously. It is of special interest to note that the blood of the patient belongs to Group I, and while there have been transfused into him blood of all four groups, without any evidence of hemolysis, he has retained his original grouping.

LEUKEMIA. At various times investigators have studied the *etiology* of leukemia, but without much success. At various times infection has been considered a factor. It has been found to follow in a few instances certain infectious diseases, and these in turn have been thought to bear some etiological relationship; thus tuberculosis has at one time or another been so considered. Recently, Ryan¹⁰³ reported a case in which *pulmonary tuberculosis* was the initial disease, and after an illness of two years the patient developed acute lymphatic leukemia, of which he died.

The cases on record of the association of leukemia and tuberculosis are classified by Rietti¹⁰⁴ according as the tuberculosis was acute or chronic or without characteristic manifestations during life. In a

¹⁰² Surgery, Gynecology and Obstetrics, 1919, xxviii, 262.

¹⁰³ Journal of the American Medical Association, 1919, lxxii, 470.

¹⁰⁴ Abstract, Journal of the American Medical Association, 1918, lxx, 202.

personal case described, a woman, aged forty-six years, had chronic myelogenous leukemia, and necropsy showed the lesions of tuberculosis in various organs, but no tubercle bacilli could be detected.

Acute Lymphatic Leukemia is discussed by Tachigara,¹⁰⁶ who states that 4 cases of this disease have been encountered in the course of ten years at the Tokyo Medical Clinic. He here reports the details of a case in a student previously healthy except that tonsillectomy had been required three years before. After a month of swelling of the glands in the neck, high fever, thirst, hemorrhagic diathesis and other signs of sepsis, the disease proved rapidly fatal, death occurring in a week, from hemorrhage in the pons region. Lymphocytes formed over 90 per cent. of the leukocytes.

Baastrup¹⁰⁶ likewise reports in detail 4 cases of acute leukemia. The patients were two unmarried women, aged about thirty-four years, and a man, aged thirty-eight years, and a boy, aged six years. In 3 of the cases the sudden onset of severe sore-throat led to the diagnosis of diphtheria. In some of the cases on record the stomatitis and gingivitis were the first manifestations of the disease to attract attention, but in the majority of cases, several weeks or months of lassitude and lack of appetite with occasional vague pains and more or less anemia generally preceded the other symptoms, but the latter then developed suddenly and in a most pronounced form. The course resembles that of acute sepsis and Baastrup believes that the infectious origin of the disease is beyond doubt.

A microbody was found in the blood of a patient with acute myeloblastic leukemia reported by Inaba and Ohashi.¹⁰⁷ The patient was given arsphenamine upon three occasions with astonishing good effects. The improvement in the blood findings was very remarkable. In consequence of the arsphenamine treatment, a great number of peculiar microbodies made their appearance in the blood. The nature of these bodies was not determined, but it is considered justifiable to regard them as a new variety of parasitic microorganism of a certain pathogenic significance in this case of leukemia.

No important advance in the *treatment of leukemia* has been made in the past year. *Transfusion* of blood is unsatisfactory, except, perhaps, as Pemberton¹⁰⁸ points out, as a temporary supportive measure for the correction of the leukemia. The report of 10 cases in Pemberton's series of transfusions justifies the statement. Lewisohn,¹⁰⁹ from an unsatisfactory experience, discourages the use of blood transfusion in all forms of leukemia. Temporary short improvement is followed by a rapid exacerbation of the disease.

Benzene continues to meet with favorable comment, though many conservative men have felt that its use is not without danger. Vaquez

¹⁰⁶ Mitteilungen a. d. med. Fakultät der k. Univ., Tokyo, 1917, xviii, 1, abstracted in Journal of American Medical Association, 1918, lxxi, 322.

¹⁰⁶ Ugeskrift for Læger, Copenhagen, 1918, lxxx, 5, abstracted in Journal of the American Medical Association, 1918, lxx, 896.

¹⁰⁷ American Journal of Diseases of Children, 1918, xvi, 1.

¹⁰⁸ Ibid.

¹⁰⁹ Ibid.

and Yacoel¹¹⁰ report 3 cases with favorable results from benzene (benzol C_6H_6) therapy. They tabulate reports from 11 other clinicians, all showing improvement in the general health, and reduction in the size of the spleen and in the numbers of leukocytes, while the numbers of reds increased. The most striking change was in the patient of Deutsch, whose whites dropped from 836,000 to 7000, but Billings has reported a case not far behind this. Even with a pathological increase in the reds, the benzene has likewise a regulating effect, but its leukocytic action is so pronounced that when given in the dose sufficient to reduce the reds from 8,000,000 to 6,000,000 it reduced at the same time the whites down to 1200. The leukocytes of normal persons are quite resistant to the benzene, comparatively speaking. Given parallel to a healthy person and to a patient with leukemia, the whites in the former dropped from 7800 to 3000 while in the leukemic it dropped from 800,000 to 16,000. They begin by giving 40 drops of benzene a day, increasing to 100 drops by the fifth day. This is continued during the first twelve days of each month, examining the blood every week and watching over the urine likewise. If the leukocytes are being destroyed too rapidly, the drug should be suspended for a fortnight. They give the benzol in capsules or in wine or milk. Given in this way it can be kept up for months. A supplementary course of radiotherapy may be useful. They alternate the courses of each. The patients in the cases reported were a man and a woman, aged fifty and fifty-one years, and a young soldier. The stimulating effect on the blood-producing organs is shown by the drop of whites from 525,000 to 15,000 in one case seven weeks after the benzene had been begun, while the hemoglobin has reached 75 per cent. and the reds gone up from 3,500,000. After this the whites ranged between 8000 and 12,000, and the general condition has kept satisfactory.

Radium and the X-rays continue to be used and in many instances with astonishing temporary improvement. A female patient, aged thirty years, was admitted to the wards of the Jefferson Hospital last summer with myelogenous leukemia. The spleen was enlarged and occupied the greater part of the abdomen, the right border touching the right iliac crest. The blood count showed 860,000 leukocytes, principally myelocytes. By the use of the x-rays alone the spleen became reduced in size so that it could be palpated just below the left costal margin and the leukocytes were reduced to less than 100,000. Her general condition markedly improved, which continues to the present writing. Obviously, she is not cured of her leukemia, but she bears testimony to the prompt and astonishing relief which the x-ray treatments gave her: treatments which are less dangerous than benzol and infinitely more efficacious than blood transfusions. Favorable results have likewise been reported from the use of radium.

MULTIPLE MYELOMA WITH BONE-MARROW PLASMA IN THE BLOOD. Beck and McCleary¹¹¹ report a case of this type and call attention to the fact that while at present there are only about 100 cases in the literature its occurrence is much more prevalent than one would have supposed

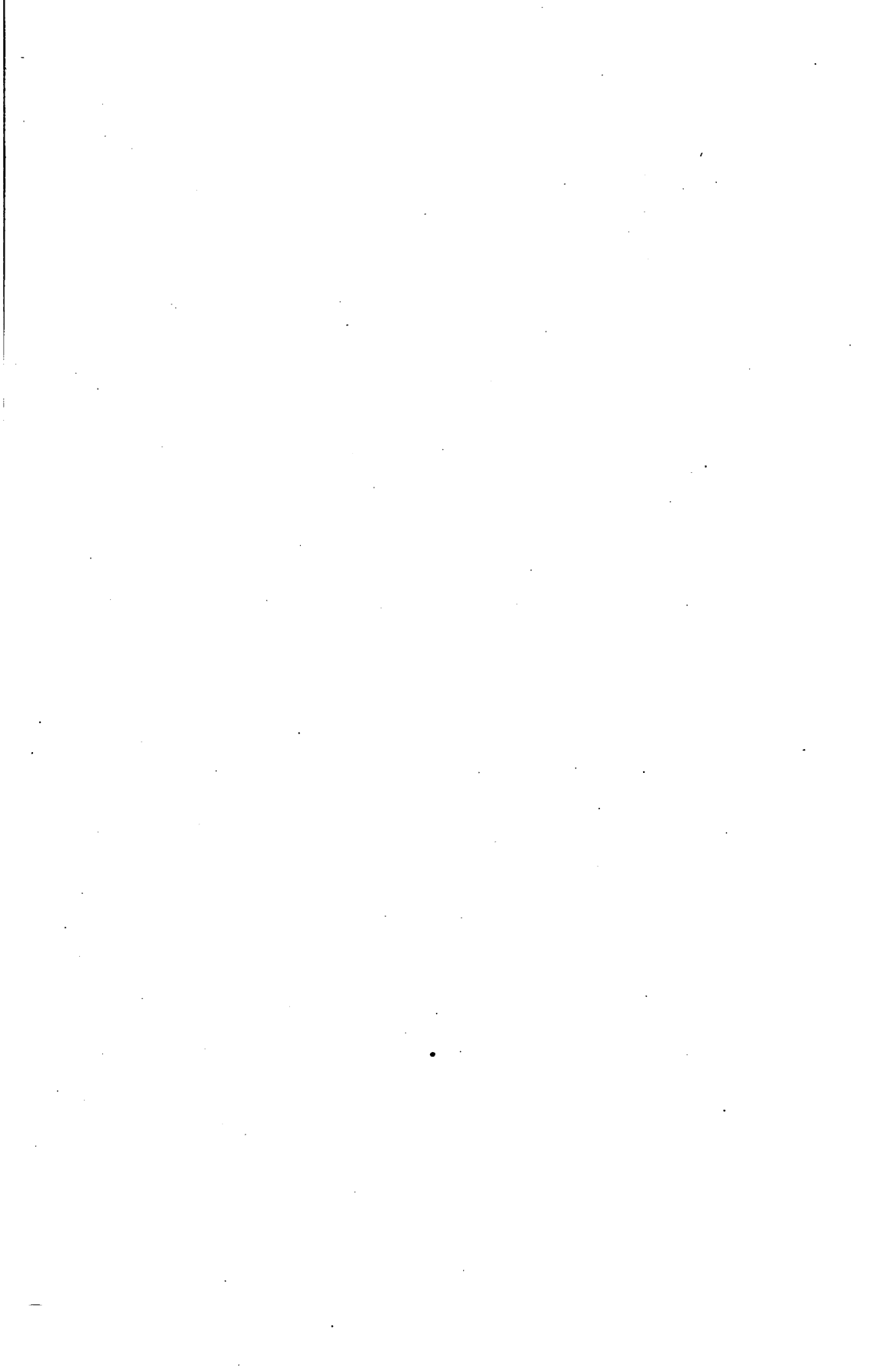
¹¹⁰ Bull. de la Soc. Méd. des Hôp. de Paris, 1918, xlii, 68.

¹¹¹ Journal of the American Medical Association, 1919, lxxii, 480.

it to be years ago and that it is gradually becoming more generally recognized. They call attention to the fact that Bence-Jones proteinuria is not pathognomonic of myelomatosis, nor is myelomatosis always attended by Bence-Jones proteinuria. It has been found in osteomalacia, in bone injury due to a gunshot wound, in lymphatic leukemia, in myxedema, in carcinomatous bone metastases and in pleural effusion. There appears to be one point in common, namely, extensive involvement of bone-marrow, which suggests the possibility of a relationship in their case of a bone lesion in typhoid with a subsequent development of myelomatosis and Bence-Jones proteinuria. The examination of the blood before death revealed plasma cells which were enumerated as irritated cells. It was not until after necropsy that the cells were identified as similar to those found in the blood-marrow.

THE BLOOD PLATELETS. Of the various elements of the blood, the platelets are the least understood. That they play some important part in coagulation is generally recognized. A reduction of the platelets in purpura hemorrhagica was first observed by Denys in 1887. Various observers since have noted a relationship between a diminished number of platelets and the liability to hemorrhage. Pratt noted a sudden drop in the platelet count preceding a severe hemorrhage in one of his patients with purpura hemorrhagica. There is a reduction of platelets in lymphatic leukemia and in pernicious anemia, but to a less degree. In hemophilia and scurvy there is no reduction in the number of platelets. The exact relation of the platelets to coagulation is uncertain. They have not been demonstrated in the circulating fluid of fishes, birds and reptiles, although clotting occurs; nor have the platelets been discovered in the serous fluids of animals. The occurrence of platelets in lymph is disputed, although this latter substance coagulates. In this connection a recent observation of Jordan¹¹² is of interest. Jordan supports Howell's assertion that lymph from the thoracic duct lacks platelets completely. The ability to coagulate resides in the presence of substances rising from the platelets which disintegrate while passing through the lymphatics to the thoracic duct, contributing thereby the small amount of prothrombin and thromboplastin characteristic of lymph; to which the lymphocytes under favorable conditions may contribute a certain additional amount, as suggested by Howell. Considering the origin of the bulk of the lymph from the plasma by way of the tissue spaces, and the continual disintegration of blood platelets, Jordan adds, the presence of these elements (thrombin and thromboplastin) in lymph can be accounted for, at least in part, on the basis of this relationship between blood plasma and lymph.

¹¹² Anatomical Record, 1918, xv, 37.



OPHTHALMOLOGY.

By WILLIAM F. HARDY, M.D.

The War and Ophthalmology. For a time the War, now happily ended, virtually preëmpted the field of ophthalmology. Opportunity was afforded for the study of the usual injuries of the eyes and in a proportionately greater degree the study of injuries unusual in peace times. Figures are available now dealing with sympathetic ophthalmia, for instance, which command respect. The question of enucleation has caused opinions to undergo a change. Eyes are no longer ruthlessly removed than are arms and legs. That day seems to be happily past. Conservation is the rule. Modern warfare has caused a great increase in the number of head and ocular injuries. Opportunity has been seized to study the effects of brain injury as represented on the visual fields. Out of this mass of study and experience there must surely come some fixed and definite data. Shell shock has proved a problem during the War and is bound to present difficulties after its close. It shows itself as headache, epiphora, photophobia, indefinite head pains, mist before the eyes and inability for sustained reading. On the medical side, conditions have made their appearance little heard of before the War. While nephritis is as old as humanity, trench nephritis is a new manifestation. It carries with it, as in all nephritides, its retinal complications. Gas conjunctivitis, keratitis and corneal ulcer were met with, due to gas warfare. Hemeralopia, or night blindness, has shown an amazing increase among soldiers, and its etiology remains somewhat veiled in doubt, though diet, exposure and physical and mental stress are thought to be potent factors. Because of the character of mutilating and disfiguring wounds about the eye, face and orbits, plastic surgery has been called upon to furnish innovations and ingenious procedures and devices. Art and mechanical skill have been requisitioned to supply the necessary prosthetic requisites. The number of blind has caused much thought on the subject of reëducation and utilization. This economic and social question will have to be met. Wonders have been accomplished and plans for their extension are under way. It is to be hoped that the returned mutilated or incapacitated soldier will not be allowed to become the ephemeral hero of today and the pauper or beggar of tomorrow.

Syphilis. WASSERMANN FINDINGS IN OPHTHALMIC DISEASE. It does not necessarily follow that because a given case shows a positive Wassermann that the disease under consideration is a syphilitic manifestation. It may be and often is a coincidence. To reach any definite conclusion therefore from a routine examination of the blood, in a series of mixed ophthalmic diseases, is very difficult. Many times an early

Wassermann test would be welcome, as in suspected chancre of the eyelid. One is usually compelled in such instances to depend on the history and clinical symptoms. Results, such as Brinkerhoff's,¹ are interesting. Of 500 cases of all kinds of ocular diseases, 209 were positive, and 291 negative. The author wisely refrained from passing judgment on the question whether, in the positive cases, the eye condition was always due to syphilis, or if, in the negative cases, it might not at times be due to syphilis. In another study, Capt. Blackwood² attempted to reduce the incidence of lues in ocular pathology to reliable percentages. The number of cases observed was too small to be of much value.

THE SELECTIVE ACTION OF SPIROCHETES. It is difficult to understand why certain syphilitics suffer with cerebrospinal or nerve syphilis while others do not unless there exist different strains of spirochetes, some having a special affinity for nervous tissue. The family cited by Grossman³ is interesting in this regard. A father had spastic hemoplegia, with pupils not reacting to light, and but slightly to accommodation. The mother was syphilitic. Three of four children had paralysis of the sphincter pupillæ and ciliary muscles. Ophthalmoplegia is rare in syphilis and may be the only evidence of the congenital disease.

PROLONGED TREATMENT OF SEVERE OCULAR SYPHILIS WITH MERCURY. Whether true or not, it seems that syphilitic manifestation of the nervous system, and particularly of the optic nerve, are on the increase. Abadie⁴ asks why this is so in view of the widespread use of salvarsan. His own theory on the subject is that the spirochete acquires increased virulence in rapid passage through many individuals, analogous to the increased virulence in other conditions, for instance, rabies from repeated transmissions. Syphilis is more disseminated now than ever before and the optic nerve and retinochoroidal lesions are alarmingly frequent. This can be abated, Abadie thinks, by attention to two points: (1) The mode of administration of mercury and (2) perseverance and continuity of treatment. Intravenous injections of cyanide of mercury are considered most efficacious, particularly so in those cases which resist all other methods of mercurial treatment. These injections should be given until thirty to forty or more have been administered at gradually lengthened intervals. Lowered visual acuity is the signal for a repetition of the injections. Perseverance in the treatment is the point insisted upon, and it is rewarded by the prevention of blindness.

Ocular Tuberculosis. With regard to the involvement of the eye by tuberculosis, Pierson⁵ brings out the fact that the spread of tuberculosis is usually by means of the lymphatics, whereas the blood stream transmits the toxins and occasionally the tubercle bacilli. The cervical and bronchial lymph glands should be looked upon as possible latent foci. The tuberculin test is of great importance and the reaction in the eye should be looked for after each injection. The smallest dose that will produce a reaction is recommended.

¹ American Journal of Ophthalmology, vol. i, p. 322.

² Ibid., November, 1918, p. 784.

³ Journal of American Medical Association, vol. lxxviii, p. 963.

⁴ Ann. d'Ocul., vol. cliv, p. 734.

⁵ California State Journal of Medicine, February, 1918, p. 74.

Weeks⁶ is partial to the use of T. O. both for diagnostic and therapeutic purposes. The length of time over which tuberculin should be given varies with the individual. Relapses will occur despite the best of care. Weeks continues treatment for two months after all signs of activity have ceased, and then keeps the patient under observation to resume treatment if any sign of relapse is discovered.

Clapp⁷ thinks the best test is that which shows a focal reaction following a subcutaneous injection of old tuberculin. The other tests are either dangerous or unreliable.

In a corneal lesion the focal reaction consists of an increase in the circumcorneal injection and extension of the corneal infiltration. With an iritic lesion the symptoms are increased circumcorneal injection, more deposits on Descemet's membrane and increased cloudiness of the aqueous. In a choroidal or retinal lesion the reaction manifests itself by greater cloudiness of the vitreous, increased edema and perhaps fresh hemorrhages if the vessels are principally involved. While it may be permissible to use rather large diagnostic doses of tuberculin, emphasis must be laid on the use of very small therapeutic doses. The temporary aggravation of a very small lesion near the macular may mean the complete and permanent blotting out of the central vision. Verheyden⁸ is of the opinion that tuberculin ought to be used more frequently in practice and that risks of accident are negligible. The frequency of ocular affections of tuberculous origin is greater than is generally supposed, according to Basterra.⁹ Spontaneous cures of severe lesions are not uncommon. Excision or cauterization of small conjunctival lesions offer the best prospect of cure. For cauterization, 50 per cent. lactic acid may be used. Surgery is advised for tuberculous affections of the lacrimal sac and duct. Other cases rebellious to local treatment respond only to sanatorium treatment.

PRIMARY TUBERCULOSIS OF THE CONJUNCTIVA, though a rare affection, is occasionally met with and should be carefully differentiated from similar appearing lesions. This is emphasized editorially by the *New York Medical Journal*, January 19, 1919, p. 128. It is met with usually in young people, and generally is unilateral. Primary conjunctival tuberculosis and lupus are microscopically identical, but are clinically different. The former gives rise to marked purulent secretion and involvement of the pre-auricular lymph node. This is not met with in lupus. Other affections to be excluded in diagnosis are epithelioma (occurring in later life), syphilis, luxurious forms of chronic trachoma and actinomycosis. To absolutely clinch the diagnosis, a piece of tissue should be removed, a part examined microscopically and the remainder inoculated into the anterior chamber of the eye or peritoneal cavity of a rabbit or guinea-pig.

Ocular tuberculosis is a disease always requiring care in diagnosis, and,

⁶ Transactions of American Ophthalmological Society, vol. xvi, p. 114.

⁷ Archives of Diagnosis, vol. x, p. 399.

⁸ British Journal of Ophthalmology, April, 1918, p. 223.

⁹ Medicina Ibera, May 25, 1918, p. 213. With few exceptions, the references to Dutch, Scandinavian and Spanish literature have been taken from current literature, Journal American Medical Association.

when occurring in the young, calls for added caution. The cases reported by Frias¹⁰ are particularly interesting because of the occurrence of a primary *tuberculosis of the iris* in a child of ten and in an infant of nine months.

Focal Infections in Eye Diseases. The question of focal infections has been rather thoroughly discussed with reference to affections in various parts of the body, including the eye. As causative factors, infections in the tonsils, teeth and sinuses have come in for the greatest attention. An instance of *retrobulbar neuritis* and one of *iridocyclitis*, the result of tonsillar infection and possessing unusual interest, were met with by Hansell,¹¹ while Bell¹² reported a case of bilateral papilledema due to empyema of the ethmoid and the sphenoid sinuses. Operation was followed by recovery. Foci may, however, be in other parts of the body.

Faith¹³ is impressed with the prevalence of focal infections as a cause of eye disease. The foci are usually chronic ones, and may be quiescent. Further, more than one focus may have an etiological bearing in a given case. Inability to find a focus is no proof that one does not exist. It is often fair, on the other hand, to assume that where one is found and ocular relief follows its eradication, that the two were associated in cause and effect. The organisms commonly met are the streptococcus, pneumococcus, gonococcus and tubercle bacillus. The uveal tract is most usually affected.

As a focus of infection, the intestinal tract is looked upon by Dwyer¹⁴ as deserving of more consideration. Intractable cases of choroiditis and iritis were found to respond to treatment in those cases in which intestinal trouble was present. When highly acid fecal specimens were present an endeavor was made to alkalinize the contents by the use of irrigation of a 1 per cent. sodium carbonate solution and colon transplantation to approach the normal. In highly alkaline specimens, irrigations of lactose are used and then the colon bacillus transplanted. Bulgarian bacilli are given by the mouth, as is also lactose, the latter to provide a suitable pabulum for the colon bacillus.

The case of blindness from retrobulbar neuritis described by Schoenberg,¹⁵ in which restoration of vision occurred after the evacuation of a congenitally dilated colon, supports Dwyer's contentions. The work of Dwyer was in the nature of an experiment, but the results in a series of 67 cases treated were noteworthy, and made the effort seem well worth while.

A Bacterial Toxin as the Cause of Retinal Hemorrhage. There is a class of cases of retinal hemorrhages the etiology of which has been veiled in obscurity. When syphilis, nephritis, diabetes, etc., exists the cause is seemingly obvious. The class of cases alluded to is usually free of these diseases. Increased blood-pressure has been assumed to account for retinal hemorrhages, but to this Lewis¹⁶ objects, as it is just as logical to

¹⁰ Vida Nueva, Havana, March, 1918, p. 100.

¹¹ Archives of Ophthalmology, November, 1918, p. 572. ¹² Ibid., xlvii, p. 344.

¹³ Illinois Medical Journal, October, 1918, p. 193.

¹⁴ Journal of American Medical Association, December 21, 1918, p. 2046.

¹⁵ Archives of Ophthalmology, January, 1919, p. 56.

¹⁶ Journal of American Medical Association, vol. lxx, p. 1813.

conclude that a weakening of the vessel wall is the fault as to infer that increased vascular tension is the cause. Substances (protein poisons) circulating in the blood may then so weaken the vessel wall by affecting the intercellular cement that the vessel breaks irrespective of the vascular tension. Search must then be instituted for the causative agent. A focal infection is suspected. Giving strength to this argument, Lewis related a case of recurring retinal hemorrhage, with normal blood-pressure and no renal trouble, which gained relief by having apical tooth abscesses receive attention. Cultures showed the abscesses to harbor the *Streptococcus hemolyticus*. The point made by Lewis appears to be well taken, and search should always be made for focal infections in obscure cases, as it is well appreciated at present how far-reaching these may prove in their effects on the human economy.

Dental Infection in Eye Diseases. The role of dental infections in causing ocular disease has of late provoked much discussion and attracted the attention of medical men and dentists. Medicine unfortunately is not free from faddism, so that dental focal infections are now having their innings. That such focal infections do occasionally cause ocular disease cannot be denied, but, in view of the great prevalence of dental disturbances, the ocular affections resulting therefrom must be relatively infrequent. These affections may be acute or chronic, chiefly the latter. The organism usually blamed is the *Streptococcus viridens* of attenuated virulence. The structures most frequently involved are the iris, choroid and ciliary body, which constitute the uveal tract. The mode of transmission of infection from tooth to eye is in dispute. Infection by way of the blood is hardly probable, which is true also for passage along nerve sheaths. Direct transmission from antrum to eye is likewise hardly possible. The most acceptable theory is that the route is by way of osseous channels or lymphatics. Homolaterality appears to be the general rule, and this is borne out by the observations of Steinbugler,¹⁷ who found the dental affection on the same side as the affected eye in 52 of 53 patients. From his study, conclusions were reached that dental infection does not produce a definite clinical entity. The streptococcus complement-fixation test is inconsistent and unreliable. Vaccine treatment is disappointing, but gives better results in acute cases than in chronic ones. The most effective therapeutic measure is the extraction of offending teeth, with the resulting drainage of the infected sockets.

Ocular Lesions of Leprosy. The rarity of leprosy in this country accounts for the disregard of this disease by the average observer. Frequently an afflicted individual will be seen by many physicians before the real condition is recognized. A common mistake is to classify such a case as syphilis. A leper at one stage or another of the disease is most likely to present some ocular condition.

Yudkin¹⁸ contends, however, that the eye, like other organs of the body, is invaded by this disease, but much less frequently and markedly. The ocular condition is usually secondary. The anterior segment is most frequently affected. The lid and corneal changes are common and

¹⁷ Archives of Ophthalmology, vol. xlvii, p. 182.

¹⁸ American Journal of Ophthalmology, vol. i, p. 303.

varied. The keratitis is of two kinds, interstitial and punctate, the latter either deep or superficial. A central leproma thins the cornea and thus gives rise to a staphyloma. Ulceration, perforation and atrophy may occur. Iris involvement may be evidenced by a nodular growth or by an iritis. The choroid and retina are less likely to be attacked. Blindness is usually due to the invasion of the anterior rather than the posterior segment.

The Oculocardiac Reflex. Pressure on the eyeball acts not only on the heart, as shown in the oculocardiac test, but also slows the rate of respiration, even to the point of apnea. This was pointed out by Achard and Binet.¹⁹ In addition, there also occurs oculo-respiratory, oculo-vascular and oculomotor reflexes. The capillary pulse is reduced. It is possible to demonstrate a diminution of the pulsations of the cerebral vessels through a trephine opening. Chills and certain tremors, particularly those of exophthalmic goitre, are lessened by pressure on the eyes. The oculocardiac reflex has been observed in pleurisy of different varieties, serofibrinous, hemorrhagic and hemothorax, by Mougeot and Colombe.²⁰

War injuries have made possible a better study of the oculocardiac reflex. Among 190 men wounded in the eyes and studied by Mougeot and Duverger,²¹ 5 developed bradycardia, probably from the concussion. In the wounded, the reflex presents a paradoxical behavior. A prognostic value is attached to the phenomenon, inasmuch as a return of the reflex after trephining has restored normal tension, indicates that the disturbance was functional and a speedy recovery is to be expected. Should the reflex, however, be permanently abolished after trephining, then a lesion is to be assumed with a more serious outlook. Dorlen-court²² found the reflex absent in 20 out of 26 cases of shock. It was lost even in the milder cases and seems to be due solely to the shock. In the positive cases it did not appear until after pressure had been applied to the eyeball for thirty or more seconds. The loss of this reflex provides new proof in support of the theory that shock is a condition of functional insufficiency of the nerve centers. It is of value in differentiating between nerve shock and posthemorrhagic pseudoshock.

Anaphylaxis. Much in the anaphylaxis theory, as applied to ocular diseases, is speculative, far removed from the practical and closely allied with the hypothetical. Starting as an explanation for sympathetic disease it is being gradually applied now to all manner of resistant ocular complaints. Some have tried to explain interstitial keratitis in this manner. Schieck²³ felt that too many difficulties needed to be explained away in assuming the direct toxic effect. He supposed that auto-anaphylaxis may sensitize the cornea; in syphilis the spirochete. Later on, trauma or other cause may awaken a new strain of spirochetes which liberate ferments, they in turn exciting the production of bodies similar

¹⁹ Paris Médicale, March 23, 1918.

²⁰ Annales de Médecine, September, 1918, p. 345.

²¹ Presse Médicale, vol. xxv, p. 730.

²² Paris Médicale, February 16, 1918, p. 130; Paris Letter, Journal of American Medical Association, vol. lxx, p. 1021.

²³ Ztschr. f. Augenhe., Bd. xxxii, S. 95.

to those antigens which have previously sensitized the cornea. The inflammation then follows. Von Szily²⁴ concluded that the importance of anaphylactic processes in ophthalmology consists in the possibility they offer of a new explanation of inflammatory conditions of the eye which are not adequately explained by the direct action of local micro-organisms or their toxins. Trubin²⁵ in his anaphylactic experiments caused degenerative changes in the retina, pigment epithelium and in the choroid. The results of his experiments gave no support to Elsching's theory. The difference between the process described and that of sympathetic ophthalmia consisted mainly in the absence of any symptoms of plastic uveitis. The proposition of Elsching that sympathetic ophthalmia might have an anaphylactic basis has produced a number of other notable contributions, among them those of Wood.²⁶ The third study of Wood furnishes a summary of the work on anaphylaxis. A pigment emulsion has been prepared from the uveal tract which is suitable for use in perfusion. This pigment is a nitrogen, hydrogen, carbon, oxygen, iron, sulphur and phosphorus-containing body, and is either a protein or closely allied to proteins. Experiments seemed to prove that this pigment was the constituent of uveal tissue responsible for its peculiar antigenic properties. The pigment possesses antigenic properties, can act as antigen in the homologous animal and is organ specific and not species specific.

The Problem of Enucleation. To the protest against unseemly haste in the enucleation of injured eyes there is added the voice of De Laperonne.²⁷ There is no excuse, except in rare and unusual circumstances, for the removal of an eye within twenty-four hours of the receipt of the injury, yet such has been done at Field Hospitals, and, worse still, double enucleations have been performed. Panophthalmitis or meningitis do not set in at once, and hemorrhage is never dangerous. Dianoux²⁸ also protested against the tendency to indiscriminate enucleations and prefers evisceration to enucleation because of the better stump. Dor²⁹ favors enucleation over evisceration. Of 63 soldiers examined by Dor, 23 had had one eye enucleated and 40 had had evisceration of one eye done. Forty-one had no complaint. Twenty-two had lachrimation, photophobia, periorbital pains and asthenopia. Twenty-one of these 22 had had evisceration performed.

The Italians resort sparingly to enucleation.

Angelucci³⁰ was compelled to enucleate but 38 of 510 wounded eyes. On the Corso, wounds of the eyes represented 1.8 per cent. of general wounds. It is a well-known fact that sight is frequently saved in eyes considered lost. The gist of the matter is that the decision for or against enucleation should be left to an oculist and not to a general surgeon.

Myopia. PROGRESSION OF MYOPIA. The early teaching was to undercorrect a myopia, the modern to fully correct. Glasses and the

²⁴ Klin. Monatsbl. f. Augenh., Bd. liv, p. 1.

²⁵ Archives f. Ophthalmology, vol. lxxxix, p. 2.

²⁶ Archives of Ophthalmology, No. 6, vol. xlv; Nos. 1, 4 and 6, vol. xlvi.

²⁷ Arch. d'Ophtal., vol. xxxv, p. 449.

²⁸ Clin. Ophtal., vol. xxii, p. 92.

²⁹ Ibid., vol. xxii, p. 204.

³⁰ Arch. Ottamologia, vol. xxiv, p. 159.

elimination of near work were looked upon as measures calculated to stem the progress of myopia. This was accepted with little question until a resumé of cases carefully treated and diligently watched showed that the myopia progressed in those disposed to progress, absolutely unhindered. Recently, Blegvad³¹ investigated 155 adults with myopia given glasses before they were sixteen. Of 50 with full correction, in 76 per cent. the myopia continued to progress. The conclusion was reached that the correction has no influence on the course of myopia. The amount of progress decreases with age. Near work increases the tendency to myopia and stimulates its progress. The earlier myopia develops the greater the degree liable to be reached. Heredity and near work are causes for the prevalence of myopia in all classes of society. No satisfactory explanation as to the cause of myopia fulfilling all requirements and answering successfully all criticisms has as yet been brought forth.

Edridge-Green³² has of late, in a rather unsatisfactory and inconclusive manner, sought to furnish an answer to this vexed question. His work is commented on editorially in the *Lancet*, May 11, 1918, p. 679. According to Edridge-Green, the primary and essential cause of myopia is an obstruction to the outflow of lymph from the lymph space between the retina and choroid into the lymph spaces of the optic nerve. This causes an increased intra-ocular tension which, in time, brings about a distention and elongation of the eyeball posteriorly where it is weakest, myopia resulting. As has been pointed out it is not clear that such a space actually exists; further, a distention of this space, assuming that it exists, would produce detachment of the retina before causing a stretching of the globe. Furthermore, glaucomatous symptoms are not present in myopic eyes except in rare and unusual instances.

Headache as a Result of Eye-strain. A large majority of headaches are attributed to some refractive error, muscle imbalance or other ocular abnormality. We have in general been satisfied with this knowledge and have not inquired why these errors cause headache and how correction gives relief. The explanation of Dunn,³³ while ingenious and attractive, fails to carry conviction. The basis of his hypothesis is that all headache is caused by an increase in intracranial pressure. This will hardly go unchallenged. Headache is an intracranial affair but the eye is an extracranial organ. To establish any connection between the two, other than a nervous one, is extremely difficult. In Dunn's theory too many deductions are based upon unproved assumptions; for instance, that variations in intracranial pressure are regulated normally by some substance secreted from the posterior lobe of the hypophysis, and that this substance has an influence upon the permeability of the cerebrospinal fluid. Again, that the hypophysis responds reflexly, not only to changes in pressure upon the cortical cells, but also upon the retinal ganglion cells. It would seem difficult to prove the assertion that the variation of pressure upon the retinal ganglia is not only subject to the normal changes in the intra-ocular circulation and the amount of aqueous, but

³¹ Ugesk. f. Laeger, February, 1918, vol. lxxx, p. 287.

³² *Lancet*, January 26, 1918, p. 137.

³³ *Archives of Ophthalmology*, vol. xlvii, p. 146.

to the relatively more violent activities of the ciliary muscle, or that over- or under-activity of the ciliary muscle creates a response in the activity of the aqueous-secreting glands. It is held that eye-strain results in a disturbance of the normal pressure upon the retinal ganglion cells, causing reflexly a disturbance of the secreting activities of the posterior lobe of the hypophysis. Continued long enough, this produces a higher than normal intracranial pressure—the clinical picture of which is headache. It is not difficult to accept the belief that headache is often the result of increased intracranial pressure but in the case of ocular headaches from eye-strain it is difficult to connect up in a continuous chain the different theoretical links fashioned by Dunn.

Tetanus in Wounds of Eye and Orbit. It would seem good practice to give a prophylactic dose of antitetanic serum in all cases of punctured or penetrating wounds of the eye or orbit. Occasionally, tetanus follows such a wound. It was met with by Sattler³⁴ following a penetrating injury to the eyeball by a dried horseweed arrow which had just been pulled out of the ground. The case was seen thirteen hours after the injury and, because of the condition of the eye, enucleation was immediately performed. Three days later, stiffness of the jaws set in, and, despite large and frequent doses of serum, the patient died in seven days. Goetz³⁵ knows of 50 cases, and advises preventive injections of serum and thorough cleansing of wounds, especially of those soiled by earth or excrements of horses. The points of entrance are the cornea, sclera and limbus, orbit, brows, lids and very rarely the conjunctiva.

Trauma of the Eye. The practitioner often finds himself in a dilemma as to the best and wisest procedure in an ocular injury. What not to do is often of greater importance than what to do. The possibilities inherent in slight injuries are often overlooked. A foreign body in the eye or a slight erosion are capable of great harm and even of loss of an eye in the presence of a dacryocystitis or even of poor lacrimal drainage. The pneumococcus is a prolific source of trouble. Attention is drawn to the subject by Wieden,³⁶ who looks upon every case of lacrimal trouble as a possible source of blindness. The measures advocated for the physician are simple, being chiefly concerned with the removal of foreign particles, thorough cleansing with bland solutions and mitigation of pain with cocaine. After this, the eye should be annointed and bandaged. Thereafter it is best to have the case in the hands of an oculist. Though it has lost much of its prestige, Wieden has faith in optochin as a remedy against the pneumococcus and uses it in all cases of lacrimal obstruction. In lieu of this, 0.5 per cent. of zinc sulphate is used. In the presence of lacrimal obstruction, the eye should not be bandaged as the secretion should have free outlet. In the destruction of the pneumococcus, the thermophore of Shahan³⁷ is to be preferred to all other measures. It is the only procedure capable of handling the situation in pneumococcus ulcer of the cornea without destroying the cornea.

³⁴ Archives of Ophthalmology, January, 1918, p. 64.

³⁵ La Clin. Ophthal., Rep. Archives of Ophthalmology, xlv, p. 502.

³⁶ Siglo. Medico, vol. lxx, p. 242.

³⁷ Transactions of American Ophthalmological Society, 1918, vol. xvi, p. 349.

RETINA AND TRACTS.

The Eye-grounds in Nephritis. The importance of eye-ground examinations in renal cases cannot be too strongly insisted upon. On this subject Kearney³⁸ states some facts which will bear repetition. Broadly speaking, the retinal manifestations may be the result of vascular changes or toxic influence. The former occur in chronic, the latter in acute nephritis. The so-called albuminuric retinitis of pregnancy is in reality a toxic retinitis, occurring in primipara in the second half of gestation. The prognosis as to life and vision depends on the duration of the pregnancy. Retinal changes are found in from 9 to 33 per cent. of renal cases, possibly 25 per cent. would be a good average. The age is usually thirty to sixty years, and especially between forty-five and fifty-five. The changes occur twice as often in men as in women. The nature and extent of the retinal lesions are no indication of the condition of the kidneys. Gross retinal changes may accompany minor kidney affections or the reverse may be true. Lues, sepsis, anemia, arteriosclerosis, phosphorus and quinine poisoning, diseases of the liver, hydrocephalus internus, brain tumor, diabetes and intracranial disease may produce retinal changes simulating renal disease. It is often difficult to ophthalmoscopically differentiate intracranial disease and renal neuroretinitis. Cushing has looked upon some of the renal retinitis cases as due to increased intracranial pressure, and has advocated cranial decompression for these. The results do not seem to justify the procedure. The vision of the patient should never be taken as an index of his retinal condition. Often gross lesions may be present with good vision. Many times the renal disease is discovered in a routine fundus examination. The prognosis is bad, death usually ensuing within two years. Kirk³⁹ examined 80 cases of trench nephritis and concluded that the retina is very liable to be involved, though gross changes are not evident. The pathology is probably an acute congestion from some specific toxin, and the exudate clears up in the majority of instances without leaving permanent results. The retinal changes do not affect the prognosis. The condition is probably allied to the acute retinitis of pregnancy, scarlatina and acute uremia, and should not be confounded with the retinitis of chronic kidney inflammation with its permanent changes.

Retrobulbar Neuritis. The most frequent cause of acute retrobulbar neuritis is held to be *multiple sclerosis* by Jocqs.⁴⁰ It is an early symptom and the cause is therefore often missed. Spontaneous recovery frequently occurs. This constitutes a functional recovery though anatomically the lesion is still present. Persons between seventeen and thirty years are most frequently affected, and the onset is usually unilateral. The first symptom is a sensation of a veil before the eye, with headache. This is followed by a central scotoma, much larger than occurs in toxic amblyopia, becoming absolute in many cases. The fundus picture is

³⁸ New York Medical Journal, November 9, 1918, p. 803.

³⁹ British Medical Journal, January 5, 1918, p. 7.

⁴⁰ La Clin. Ophthal., vol. xxii, p. 257.

negative and general nervous symptoms may not follow for many years. The acute neuritis does not last longer than eight weeks.

The role of *the teeth* in causing ocular trouble has of late been much dilated upon. Dor⁴¹ takes a rather extreme view of the etiological influence of dental conditions in causing retrobulbar neuritis. He cited 19 out of 20 cases following a slow periostitis at the root of the bicuspid teeth of the superior maxilla. Pivots, gold crowns and root-remains are also said to cause the inflammation. Dor further claims that many detachments of the retina, venous thromboses, hemorrhages, embolisms, choroiditis, iritis, keratitis and even cataracts have their origins in affections of the bicuspid.

A case of retrobulbar neuritis manifesting itself clinically by a sudden onset of blindness is recorded by Schoenberg.⁴² It was presumably due to *retained* and fetid feces in a congenitally dilated colon of a child aged four years. Weight is given this assumption by reason of the fact that vision immediately began to improve very soon after the expulsion of a large amount of feces.

That *tonsillar infection* may excite a retrobulbar neuritis is exemplified by Hansell's⁴³ case.

Evidence is ever increasing which demonstrates the close relation between the optic nerve and *nasal sinuses*. The work of Onodi and of Loeb in this connection has brought out the intimate anatomical relationship. Possibly the retrobulbar effects have been less commented on than those occurring more anterior. Chronic ethmoid sinusitis accounted for the case of retrobulbar neuritis with scotoma and enlarged blind spot recorded by Malling.⁴⁴ Here improvement at once followed correct nasal treatment with disappearance of the scotoma and return of the blind spot to normal. Before operation all the symptoms were better when the discharge from the nose was free. This fluctuating course together with the retrobulbar neuritis and secondary atrophy is viewed as characteristic of the rhinogenous type of eye disease.

The tragic results in Lambert's⁴⁵ patient illustrates the speed with which one may be rendered blind from retrobulbar neuritis. Eight days from the onset of an acute bilateral retrobulbar neuritis, of probable septic origin and possible sinus focus, total and permanent blindness supervened.

The *absorption of toxic substances* into the economy is capable of setting up a retrobulbar neuritis which eventuates in atrophy. Powder makers handling *nitrophenol bodies* are susceptible. Sollier and Jousset⁴⁶ have directed attention to this subject. It was suggested that blame might be placed on the dilatation of bloodvessels produced by nitre products. The symptoms come on after six to twelve months, evidenced by cramps and formications, slow loss of vision and difficulty in reading. There is early an edematous neuritis and, finally, a white atrophy. The

⁴¹ La Clin. Ophtal., vol. xxii, p. 204.

⁴² Archives of Ophthalmology, January, 1919, p. 56.

⁴³ Ibid., November, 1918, p. 572.

⁴⁴ Norsk Mag. f. Laegevidensk, April, 1918, p. 414.

⁴⁵ Archives of Ophthalmology, November, 1918, p. 609.

⁴⁶ La Clin. Ophtal., vol. xxii, p. 78.

possible sources of entry of the poison, cutaneous absorption, inhalation and ingestion by mouth are perhaps all implicated.

Absorption through the skin and mucous membranes is considered the portal of entry of *binitrotoluene* by Hamilton and Nixon.⁴⁷ This chemical, the product of the manufacture of explosives, has a transient and perhaps permanent effect on the central nervous system, and in Hamilton and Nixon's case produced optic atrophy after prolonged exposure.

Wood Alcohol Blindness. Mention is repeatedly made by writers and by societies of the dangers of wood alcohol, not only in beverages and food articles, but in the arts and industrial uses. There seems to be no good and valid reason for the common use of wood alcohol. That it need not be ingested to produce blindness is illustrated by the case of Robinson,⁴⁸ wherein blindness resulted from the spattering of the hands in a workman engaged in dyeing hats with a commercial product called "Colorite," which contains 4 per cent. of wood alcohol. In this patient there was no evidence of syphilis, and the history revealed the fact that he was an abstainer from alcoholic drinks. Sight began to grow smoky after six weeks' employment with "Colorite."

Night Blindness. The war has demonstrated that night blindness is quite frequent in soldiers. In some it may have resulted from a luetic retinitis, congenital or acquired. Other cases, not so apparent, are mentioned by Magitot.⁴⁹ No objective findings may be present; the condition can then be congenital or inherited. It has been observed after lightning stroke as a concomitant of kidney and liver disease and sclerosis in the elderly. None of these causes hold good in the soldiers. A lack of vitamins in the food has been suggested as a factor. Predisposing conditions are myopia, mental and physical stress, auto-intoxication and abuse of alcohol. These may transform a relative hemeralopia, of which the subject was unaware, into an active one. Lavron reported 80 per cent. of adult males in a certain Russian district suffering with hemeralopia, due to poor food and excessive physical labor. Night blindness was a common complaint among soldiers from the Salonica front. This was regarded by many as the result of malaria, but Kirk⁵⁰ dissented from this view and found that in a large number of the cases latent refractive errors which were present became active by reason of sun glare, dust and exposure, and enhanced by the debilitating influences of malaria. The night blindness was invariably associated with and accounted for by anemia. The hypermetrope in tropical countries seems to be especially liable to this complaint. The *New York Medical Journal*, June 22, 1918, p. 1190, remarks editorially that in spite of the variety of causes it seems difficult to account for so many cases in soldiers. It is stated that the disease in early times was common during a siege when men were worried and ill-nourished. It may assume epidemic form, as was shown by the writings of Jacques de Vitry and the investigations of Lavron. In the absence of organic disease, rest in bed

⁴⁷ Journal of American Medical Association, vol. lxx, p. 2004.

⁴⁸ Ibid., vol. lxx, p. 148.

⁴⁹ Paris Médicale, May 11, 1918, p. 369.

⁵⁰ British Medical Journal, August 3, 1918, p. 110.

on a milk diet and the elimination of meat afterward will generally suffice for a rapid cure. A number of authors have reported beneficial results from the incorporation in the diet of liver. V. Stenitzer and Schroder,⁵¹ from their experiences in feeding cooked liver, were unable to concur in this opinion.

The Ocular Complications of Lethargic Encephalitis. In the last two years quite a number of articles have appeared in medical literature dealing with lethargic encephalitis, which is by some looked upon as a new disease. The suggestion has been made by Sainton⁵² that the affection is the expression of the localization in the brain of the prevailing influenza. It is almost always accompanied by ocular symptoms. Absence of these casts doubt on the correctness of the diagnosis. Morax⁵³ has given attention to the subject from the ophthalmologist's viewpoint.

Netter's description of the affection is as follows: The disease usually runs a febrile course, begins with headache and sometimes with vomiting. There is at first only drowsiness, but this is followed by a true sleep, which, in advanced cases, goes on to coma. There may be delirium, trembling and rarely convulsions. The muscular apparatus of the eyes is almost always affected; paralysis, ptosis, nystagmus and more rarely diplopia. The usual signs of meningitis are lacking and the evidence from lumbar puncture is against this diagnosis. The brain is macroscopically normal, but microscopically shows definite changes. The duration of the disease is variable, death occurring in some cases in a few hours, in others the illness is prolonged for over three weeks. Lethargic encephalitis affects the ocular muscles, involving principally the third and sixth pairs, but in an incomplete manner. A complete paralysis limited to one ocular motor nerve, as in cerebral syphilis, is not observed. The disturbances are often bilateral. Papillary edema and other fundus changes are not noted, and an alteration in the cerebrospinal fluid upon which papilledema is based has not been observed. The cause of the disease has not been determined, but reasoning from the effect on the ocular muscles in botulism, the hypothesis has been advanced that alimentary intoxication is the etiological factor. There is nothing definite, however, to support this view. The prognosis is bad, about one-third of the cases dying. When recovery ensues there may be a complete restitution to normal, even after serious functional symptoms. The duration of the ocular symptoms cannot yet be definitely determined.

Papilledema and Lumbar Puncture. As causes of choked disk in the order of frequency are listed tumors, syphilis, tuberculosis, hydrocephalus, hemorrhages and abscesses. Marin,⁵⁴ however, found tuberculous meningitis to be the most frequent cause. Repeated lumbar puncture was performed as a therapeutic measure, which procedure

⁵¹ Hospitalstidende, vol. lxi, p. 481.

⁵² Presse Médicale, September 23, 1918, p. 487.

⁵³ Ann. d'Ocul., July, 1918, Translation, British Journal of Ophthalmology, vol. ii, p. 529.

⁵⁴ La Clin. Ophthal., vol. xxii, p. 395.

the author felt was beneficial by reason of the elimination of toxins and further by reason of the good effect on the intracranial circulation. Lumbar puncture is much less radical than colossal puncture or trephining. The amount of fluid removed varies with the age of the patient and the effect on the disk, which latter is held to be the best guide. Usually 20 to 30 c.c. are removed in adults.

Ophthalmic Changes in Tabes and Paresis. From a study of 122 clinic cases, Wechsler⁵⁶ gained the impression, particularly with reference to the optic changes, that there is no fundamental difference between tabetic neurosyphilis and so-called cerebrospinal neurosyphilis. An inflammatory process is held responsible for every form of syphilitic involvement, and that the spirochete is the cause. The inflammatory reaction differs with the tissue affected. One would expect a vascular structure, like the meninges, to react more violently than the brain parenchyma. Lymph- and plasma-cell infiltration and mast cells are characteristic of syphilis. Such findings occur in tabes, paresis and optic atrophy, the same as in interstitial neurosyphilis. The term cerebrospinal syphilis is too general and covers a variable clinical picture. Inflammatory reactions have been found even in very old cases of optic atrophy. It is urged that the term primary optic atrophy be dropped or to indicate it as the atrophy which takes place *pari passu* with the inflammatory exudative process. It is equally descending with an inflammatory neuritis, though the vascular changes are not nearly so violent. The recognition of the inflammatory character of optic atrophy may prove the basis of a rational therapy.

Quinine Poisoning. Elliot⁵⁶ has reviewed the subject of quinine poisoning and decries the tendency to give large doses of the drug, especially to soldiers in malarial districts. "To save a man from death only to leave him amblyopic, hemeralopic or with contracted fields is to render him a poor service indeed." There is a limit to the amount of the drug that can be taken up by the blood, a large part is not absorbed, especially in intramuscular injections. The drug is usually taken by the mouth, but amblyopia may result from rectal administration, as happened in the case reported by Nagel.⁵⁷ Those once poisoned are very susceptible to even small doses. The interval between the ingestion of the drug and the onset of blindness is variable. A few cases seem to have suffered a cumulative effect. In 2 cases blindness was described as instantaneous. It is doubtful if complete vision is ever restored in an amaurotic case. It improves up to a certain point and may then recede. Narrowing of fields is a constant symptom. Central color vision is absent or deficient, but may be completely restored. The pupils are usually dilated and fixed. Pallor of the disks is a characteristic picture, as is also extreme contraction of the arteries and veins of the retina. Reference has been made in Ballantyne's⁵⁸ case to the fact that loss of vision may be complete

⁵⁶ New York State Journal of Medicine, August, 1918, p. 304.

⁵⁶ American Journal of Ophthalmology, August and September, 1918, p. 547.

⁵⁷ Ibid., January, 1919, vol. ii, p. 54.

⁵⁸ PROGRESSIVE MEDICINE, 1918, p. 363.

in quinine-poisoning, although the early ophthalmoscopic appearances are normal. Deafness is early and passes away quickly. Confusion in differentiating signs of quinine-poisoning from those of various severe fevers should not occur. This is particularly true of children who, as a result of error, may be condemned to life-long blindness. Elliot inclines to the view that in quinine amaurosis we have to do with a specific toxemia, a feature of which is a powerful selective action. As to treatment, the drug must be stopped, though some claim life with blindness is preferable to death, and so continue the drug. Their diagnosis must be certain. A multitude of remedies have been used, strychnine subcutaneously, vasodilatation with amyl nitrite or nitroglycerin, digitalis, bromides, massage, Bier's hyperemia and the assuming of the recumbent posture. Elliot offers the tentative suggestion that operative measures be given a trial, for, by lowering intra-ocular tension from normal to subnormal, an increased supply of blood to the eye is brought about. This latter suggestion cannot make a strong appeal, especially if one takes the position that the trouble is the result of a definite toxemia with a selective action on the cells of the retina. The ancient remark that where many measures are recommended none has any great value, appears to be as true in quinine amblyopia as in other conditions.

Disturbances of Vision from Head Injuries. Head injuries may give rise to a variety of ocular disturbances. Primary optic atrophy in children is unusual, so that a unilateral optic atrophy in a child immediately arouses the suspicion of trauma. Brav⁵⁹ met with such a case, in a child of four, which had suffered a fracture of the skull. The trauma may affect the nerve directly or indirectly by pressure, which is usually anterior to the chiasm.

Comotio cerebialis from head concussions is a rather indefinite term. It is defined by Coutela⁶⁰ as "visual disturbances of purely functional type not showing the features of organic affections, as at present recognized, and not corresponding to demonstrable macroscopic lesions, disturbances consecutive to a cranial traumatism, whatever its cause, whether it be the action of an explosive or any contusion-producing body." The symptoms may be transient. The blindness, at first absolute, may improve rapidly. The element of hysteria must of necessity be ruled out in differential diagnosis.

War wounds have made a thorough study of cerebral localization possible. Injury by bone fragments in the vicinity of the superior lips of the two calcarine fissures, in a case described by Cosse and Delord,⁶¹ produced a right lateral homonymous hemianopsia with a left inferior quadrant hemianopsia, the only part of the visual field left intact being the left superior quadrant. Each eye had preserved a normal central visual acuity. Souques and Odier⁶² met with a shell wound in the occipital region with total blindness which disappeared and in two months gave place to a left macular hemianopsia, the rest of the field being normal, and to two

⁵⁹ Journal of American Medical Association, vol. lxx, p. 1595.

⁶⁰ Ann. d'Ocul., vol. cliv, p. 313.

⁶² Revue de Neurologique, vol. xxiv, p. 248.

⁶¹ Ibid., p. 118.

paramacular scotomata, the one at the left of the meridian, the other at the right, exclusive paramacular and sparing entirely the right side of the macular field. The visual phenomena observed seem to argue for the existence of a circumscribed cortical macular center localized in the posterior part of the occipital lobe. Morax⁶³ examined a patient struck in the occipital region by a projectile which split into three fragments. The vision, at first feeble, became normal except for a left hemianopsia. In addition, there was a neuromyolytic keratitis of the right eye and a paralysis of the "dextrogyres."

Gordon Holmes,⁶⁴ from his observations, concluded that the upper half of each retina is represented in the dorsal, and the lower in the ventral part of visual area. The center for macular or central vision lies in the most posterior part of the visual areas. The macula has not a bilateral representation. The periphery of the retina is represented in the anterior portions of the visual areas. The defects of vision in the fields of the two eyes are always congruous and superposable if no disease or injury of the peripheral visual apparatus exists. Lesions of the lateral surfaces of the hemispheres, particularly of the posterior parietal regions, may cause certain disturbances of the higher visual perceptual functions with intact visual sensibility, as loss of visual orientation and localization in space, disturbance of the perception of depth and distance, visual attention loss and visual agnosia. Another interesting and important study of ocular affections in wounds of the cranium was made by Velter.⁶⁵

PUPIL AND UVEAL TRACT.

Argyll-Robertson Pupil. The half-score of cases of traumatic dissociation of pupillary reflexes reported before 1914 appear vastly increased in number by the European war. Magitot⁶⁶ emphasized the influence of ocular trauma on the unilateral dissociation of the iridic reflexes. In 3 cases of traumatic Argyll-Robertson pupil there was myosis. Bollack⁶⁷ is of the opinion that the cases appearing after traumatism should bring more precision to its pathogenesis since the lesions are often more localized and have a certain almost experimental value. The Argyll-Robertson sign has long been looked upon as exclusively a manifestation of syphilis. The possibility of its appearance in alcoholism, diabetes and cerebrospinal meningitis has been demonstrated. In those cases following trauma, the exact seat of the lesion has not been agreed upon. Bollack's case was one of unilateral Argyll-Robertson sign with miosis (which is the usual finding) from an intra-orbital fragment of shell.

THE PUPILLARY REACTION IN CHRONIC ALCOHOLISM AND ALCOHOLIC PSYCHOSES. The much-debated motor control of the sphincter pupillæ has been shown clinically and experimentally to reside in the ciliary

⁶³ Ann. d'Ocul., vol. cliv, p. 300.

⁶⁴ Lancet, 1918, cxciv, 61.

⁶⁵ Ann. d'Ocul., vol. cliv, p. 553.

⁶⁶ Ibid., 1918, clv, p. 228.

⁶⁷ Arch. d'Ophtal., 1918, xxxvi, p. 106.

ganglion. The Argyll-Robertson pupil is assumed to be due to a degenerated or unresponsive ciliary ganglion. Clinical evidence supports this view. The exact effects of alcohol on the pupil except in acute alcoholic states have few references in the literature. Leahy's⁶⁸ observations have shown that in some cases of chronic alcoholism and the various types of alcoholic psychoses, there is temporarily a definite absence, sluggishness or limitation of reaction. The pupils are often widely dilated and then show an absence of light reaction, or the pupils may be moderately dilated, but with a definite limitation of range and sluggishness of reaction. After two or three days, however, the pupillary reaction was found to be normal.

Siderosis Affecting Innervation of Pupil. Dilatation of the pupil following siderosis has been noted by a number of observers. Vossius ascribed it to a chemical irritation of the sympathetic fibers of the iris. Tuckett⁶⁹ believes that iron salts produce an injury to the endings of the third nerve in the iris rather than stimulation of the sympathetic. Amplifying the observations of Tuckett, Verhoeff⁷⁰ states that, from his investigations, it appears that the impaired motility of the iris in siderosis bulbi is not due to selective action on nerve terminals, but to impairment in function of the muscles of the iris resulting from their affinity for iron. He finds that the cells of the dilator, and to a less extent those of the constrictor muscles also, become densely packed with iron pigment in cases of siderosis bulbi, more so than any other cells in the iris.

Etiology of Iritis. One significant statement of Jackson,⁷¹ regarding iritis is that the treatment is chiefly extra-ocular. To unearth the etiology of iritis in a given case is the duty of both ophthalmologist and internist. Evidence points to focal infections, especially those connected with the teeth, as a frequent cause of iritis. The specific diseases, lues, gonorrhea and tuberculosis, are still to be regarded as most important etiological factors, but not to the extent formerly believed. The work of Brown and Irons⁷² did much to put our knowledge of the causes of iritis on an accurate basis. The former teaching that one-half of the cases were due to syphilis, one-fourth to rheumatism and the other fourth to various other causes, no longer holds good. Within the last few years rheumatism has been displaced as a common cause of iritis. The term rheumatism is too general and means too little. It may be the result of the same cause as the iritis.

Iridocyclitis. IRIDOCYCLITIS FROM MUMPS. The references to iridocyclitis accompanying mumps are few. This Weve⁷³ thinks is due to the fact that the iridocyclitis generally preceded the mumps by several weeks. This causes the parotitis to be looked upon as an intercurrent infection. Weve reported 3 cases in which epidemic parotitis was evidently responsible for iridocyclitis. The disease was very resistant to treatment and only succumbed when radium was used. Heerfordt, in

⁶⁸ New York Medical Journal, April 20, 1918, p. 743.

⁶⁹ British Journal of Ophthalmology, February, 1918, p. 79.

⁷⁰ Ibid., November, 1918, p. 571.

⁷¹ Colorado Medicine, March, 1918, p. 63.

⁷² Transactions of American Ophthalmological Society, vol. xiv, p. 495.

⁷³ Nederl. Tijdschr. v. Geneesk, February 23, 1918, p. 544.

1909, published reports of 3 cases of chronic bilateral parotitis accompanied by chronic iridocyclitis. Other reports have been furnished by Kuhlefeldt and by Mackay.⁷⁴

Iridocyclitis from Dysentery. Maxwell and Kiep⁷⁵ observed 6 cases of iritis or cyclitis in subjects with infection with the *Bacillus dysenteriae* (Shiga). In 4 of them arthritis occurred as well. The ocular affections appear about one month after the first sign of involvement of the bowel, but may occur as early as the twelfth day. The articulo-ocular syndrome corresponds exactly to that occurring in another affection of the mucous tract, *viz.*, gonorrhea, as pointed out by Garrod.

The Action of Miotic Drugs on Eyes with Incomplete Sphincter Iridis. Opinions are contradictory regarding the response of the incomplete iris sphincter to miotics. Curdy,⁷⁶ in endeavoring to settle this point, reached the conclusion that physostigmine can produce contraction of the pupil, narrowing of the coloboma and reduction of the glaucomatous tension in iridectomized eyes. The contraction of the pupil and coloboma indicate that there is a relaxing effect on the radial fibers of the iris, as well as the spastic effect on the sphincter. The action of the ciliary body is a factor in the reduction of the glaucomatous tension produced by physostigmine. It is probable that miotics and mydriatics have no power to increase or diminish the extent of radial tears of the iris. Carr⁷⁷ contends that miotics in normal eyes do not lower the tension, following the contraction of the pupil, greater than 3 mm. Hg., which variation is well within the recognized limits of error in the use of the tonometer.

The Treatment of Prolapse of the Iris. The proper treatment of prolapse of the iris varies to a great extent with the duration of the prolapse. This is true whether it results from a penetrating wound or a perforating ulcer. Generally speaking, it is bad policy to leave a part of the uvea exposed. When such a condition has existed for several days, the anterior chamber is shut off and the iris is sealed to the edges of the wound by plastic exudate. To disturb this condition is to invite infection, so that the old small prolapses are let alone to flatten down in time. Naturally, a leukoma is present, and there is an anterior synechia capable of subjecting the ciliary body to constant traction and irritation. Ramsay⁷⁸ insists therefore on distinguishing between cases of recent and those of more than forty-eight hours' standing. Seen early, a prolapse from a penetrating wound of the cornea away from the limbus calls for atropine; if near the limbus, for eserine; in either case, the purpose is to pull the iris away from the wound and prevent further prolapse. Usually, however, the bruised and prolapsed iris must be excised under the strictest aseptic conditions. The chief objects are to prevent an anterior synechia and escape infection. Freedom from infection is enhanced by drawing a conjunctival flap over the wound or by circumcising the cornea, putting

⁷⁴ PROGRESSIVE MEDICINE, 1918, p. 356.

⁷⁵ British Journal of Ophthalmology, February, 1918, p. 71.

⁷⁶ Journal of the American Medical Association, vol. lxx, p. 1992.

⁷⁷ Archives of Ophthalmology, vol. xlvii, p. 177.

⁷⁸ British Journal of Ophthalmology, November, 1918, p. 554.

in a purse-string suture and drawing the conjunctiva completely over the cornea. Large prolapses are dealt with surgically. In some cases Ramsay burns down the prolapse with a galvanocautery and slides over a conjunctival flap. This procedure appears dangerous, for the use of a cautery on uveal tissue possesses the possible danger of inciting a sympathetic ophthalmia.

Sympathetic Ophthalmia. All authors at present seem in agreement on the question of the lessened incidence of sympathetic ophthalmia. The war demonstrated that it is less frequent than formerly supposed, which has been commented upon by Dimmer⁷⁹ and others. It is stated that literally thousands of men are walking the streets of Europe with particles of glass, stone, wood, iron, copper and other substances in an eye with no evidence after a number of years of sympathetic disease in the uninjured eye. Weekers⁸⁰ favors conservatism. If, in a month or more, the eye remains painful and irritated, removal is necessary. One should not wait a long time if the eye atrophies or exhibits an exudative iridocyclitis. The diminution of the frequency of sympathetic disease is due above all to more and more vigorous regard to asepsis and antisepsis. Operative infected wounds accounted for the majority of the 30 cases examined by Morax⁸¹ in the last twenty years. A small number only resulted from accidental penetrating wounds with incarceration of the iris. Angelucci⁸² resorts sparingly to enucleation and urges a careful study of the case before deciding on the removal of the injured eye. True sympathetic ophthalmia usually develops after the second week, and after eight weeks the danger is nearly past. The question is asked, Does enucleation completely guard against the danger from sympathetic ophthalmia? The consensus of opinion is in favor of early enucleation in irreparably injured eyes when sympathetic disease is thought possible. Dissenting views are heard, Poulard,⁸³ for instance, contending that ophthalmologists entertain too great a fear of sympathetic disease. The objection is also raised that total removal possesses so many drawbacks that partial ablation should be substituted. It is true, as Poulard states, that sympathetic ophthalmia is a relatively rare disease, but it does exist and no conscientious physician desires to run the risk of having a totally blind patient for the sentimental reason of keeping the eyeball in the head. Instances are cited where the trouble occurred despite the early removal of the injured eye. The case detailed by Poulard⁸⁴ is no good argument against preventive enucleation. It clearly indicates that enucleation was delayed too long, for if Elsching's theory of anaphylaxis is correct, an injured eye which has remained in the head forty days, as in Poulard's report, has had ample time to sensitize the uveal tissue of the other eye.

Operations for traumatic cataract are fraught with some danger of sympathetic ophthalmia. Valude related such a case. Morax observed only one case of sympathetic ophthalmia in 1500 wounded soldiers but

⁷⁹ Klin. Monatsbl. f. Augenh., lvii, 257.

⁸⁰ Archiv. Med. Belges, vol. lxx, p. 193.

⁸¹ Ann. d'Ocul., vol. cliv, p. 363.

⁸² Archiv di Ottal., vol. xxiv, p. 159.

⁸³ Ann. d'Ocul., vol. cliv, p. 697.

⁸⁴ Ibid., p. 702.

this case followed cataract extraction done two weeks after the injury. In this case, however, there was a prolapse of iris which was treated with the galvanocautery. This illustrates the unwisdom of using a cautery on uveal tissue. Numerous references have been made to the similarity between the microscopic characters found in sympathetic ophthalmia and those in tubercular infections of the eyes. With this in mind, Wood⁸⁵ injected T. O. in two cases with sympathetic ophthalmia and obtained a marked focal reaction in the sympathizing eye. No benefit was derived. Both cases had had salvarsan with likewise no benefit. Wood very tentatively suggests the possibility of sympathetic ophthalmia being due to symbiosis between the tubercle bacillus and some unknown protozoön.

Much value for a time was attached to the blood count as indicating the presence or heralding the imminence of sympathetic ophthalmia. This was stimulated by the researches of Gradle, Browning, Price Jones, Ormond and others. Conflicting findings made their appearance, which cast doubt on the value of the blood count in this disease. Gifford⁸⁶ sought to satisfy himself with regard to conflicting testimony. Counts were made in true sympathetic ophthalmia, in other processes, possibly sympathetic ophthalmia cases, in certain chronic affections and uveitis, in vernal catarrh and lastly on a normal person, *viz.*, Gifford himself. The opinion was arrived at that mononucleosis is not specific for sympathetic ophthalmia, but is found as a reaction of the body to a chronic inflammatory process in the eye of whatever cause. In view, then, of the frequency with which it occurs in other conditions and the occurrence of cases of true sympathetic ophthalmia in which it is absent, it would seem very doubtful if the sign could be considered of any importance in determining the presence or absence of sympathetic ophthalmia or the likelihood of its developing in any case.

MUSCLES AND MOVEMENTS.

Transient Relapsing Enophthalmos. A unique and interesting case of transient unilateral relapsing enophthalmos, associated with pregnancy, was reported by Gonzalez.⁸⁷ The attacks came on suddenly, the eye sinking into the orbit, the palpebral fissure narrowing and the skin of both lids becoming white and bloodless. The seizure lasted fifteen minutes. In addition, there were ptosis, miosis, and hypotonus. The condition was looked upon as an evidence of relapsing sympathetic paralysis due to the pregnancy, but it is difficult to explain in just what manner this is brought about.

Infective or Toxic Ophthalmoplegia. A number of limited epidemics of acute toxic ophthalmoplegia have been reported. Harris,⁸⁸ in a short period, saw 7 cases; 2 followed the eating of sardines and 1 after canned

⁸⁵ British Journal of Ophthalmology, January, 1918, vol. ii, p. 27.

⁸⁶ Archives of Ophthalmology, vol. xlvii, p. 327.

⁸⁷ American Journal of Ophthalmology, 1918, p. 713.

⁸⁸ Lancet, April 20, 1918, p. 568.

salmon, but there was no direct proof of cause and effect. The symptoms have been grouped as follows:

1. Incubation period of not less than twelve to twenty-four hours.
2. Arrest or hypersecretion of salivary or buccopharyngeal glands.
3. Ophthalmoplegia externa and interna, ptosis, mydriasis, divergent strabismus and diplopia.
4. Dysphagia, aphonia, intractable constipation, retention of urine, and occasionally severe vomiting.
5. Disturbances of circulatory and respiratory systems.
6. Absence of fever and of disturbances of sensation and intelligence.

Hall⁸⁹ observed 10 cases. They were divided provisionally into two broad groups: (1) The meningitic, (2) the asthenic. No real division is possible as some cases have symptoms common to both. The relation of this condition to botulism or food poisoning appears to be an intimate one. The symptoms are sufficiently serious and alarming to give the care of food, which in these times is largely substitutes, the deepest consideration.

Oculomotor Paralysis from Intraspinal Anesthesia. Reports have appeared from time to time with regard to the deleterious results following intraspinal anesthesia. Of the ocular muscles affected, the external rectus seems particularly unfortunate. It is gratifying to know that the involvement is, as a rule, transitory and subsides usually in a few weeks. Dameno⁹⁰ has added the report of 4 cases of temporary paralysis following intraspinal anesthesia with novocaine. The external rectus was affected and the trouble subsided by the end of three weeks.

Nystagmus (Latent). Latent nystagmus, which develops only with monocular vision, being absent when both eyes are used, is of rare enough occurrence to elicit interest. Furthermore, the possibility of serious results ensuing in case one eye is rendered unfit for vision, thereby arousing the latent nystagmus into an acute one, must be taken into consideration. Dorff,⁹¹ in 1914, reported several cases and reviewed the literature to date. Jacobs⁹² observed latent nystagmus in a boy, aged fourteen years, and discussed the theories regarding the cause of this condition. Van der Hoeve⁹³ described 8 cases with apparently normal conditions except when one eye was covered. It cannot be said that any really satisfactory explanation is at hand for the condition. It is assumed that there exists a supranuclear tonic association center which controls the ocular movements associated with binocular seeing. Of late years the possibility of the ear influencing the nystagmus has been minimized by the insistence that all cases coming under the classification of latent nystagmus be otologically negative. As Jacobs states, the subject is still largely theoretical and the solution of its problem depends on the acquiring of a better knowledge of the centers which control motility. It has been stated that conditions gradually right themselves and the nystagmus disappears in time.

⁸⁹ Lancet, April 20, 1918, p. 568.

⁹⁰ Prensa Medica, Argentina, vol. iv, p. 417.

⁹¹ Annals of Ophthalmology, vol. xxvi, p. 128.

⁹² American Journal of Ophthalmology, March, 1918, p. 171.

⁹³ Nederl. Tijdschr. v. Geneesk. March 23, 1918, p. 790.

NYSTAGMUS (VOLUNTARY). Voluntary nystagmus is quite unusual and few instances have been reported. Gowland⁹⁴ had a patient who was able to produce at will a horizontal nystagmus which persisted in every direction in which the eyes were moved. A strong concentration of will power upon the eyes was necessary to produce the condition. According to Raehlmann, true voluntary nystagmus appears only in patients with marked visual anomalies which have existed since childhood. This however, was not true of Gowland's patient.

NYSTAGMUS FOLLOWING CONCUSSION. Three cases of nystagmus following concussion were recorded by Moreau.⁹⁵ The labyrinth could not be incriminated by otologists, nor a localization established by neurologists. They followed trauma, were permanent, constant, without variation, lasting one year, twenty-one months and nine months, respectively, and not influenced by lumbar puncture. There was a lowering of vision, not progressive and without ocular lesion. To this diminution of vision there was added, in 2 cases, a homonymous diplopia which persisted without variation since the first examination. Moreau did not attempt a pathogenic hypothesis nor identify the facts of the syndrome with Deiters's nucleus.

Associated Movement Existing between External Rectus and Masseter. A unique case of interest because the condition was acquired and not congenital was reported by Posey and Schwenk.⁹⁶ The associated movement existed between the paretic external rectus and the masseter. The subject with this condition had suffered a crushing accident to the head twenty years before. The paresis of the external rectus muscle with the eyes in the primary position was apparently complete. Synchronous with a firm contraction of the masseters, the external rectus would regain its power and contract, rotating the eye outward almost as though it had regained its normal stimulus. The explanation of the phenomenon was thought to be due to some peripheral union between the fifth and sixth nerves subsequent to the head injury. It seems possible to establish a communication from the inferior maxillary nerve through the Otic and Meckel's ganglion to the sixth nerve.

Malaria and Diseases of the Eye. Malaria has been held accountable for numerous eye diseases, including conjunctivitis, keratitis, corneal ulceration, iritis, retinochoroiditis, optic neuritis, opacities of the vitreous and lens, nerve paralysis, retinal hemorrhages, etc. To this long list Kirk⁹⁷ takes exception. The majority of these ocular diseases are no more common in malarial districts than in tropical non-malarial countries. The question seems to be more one of physical resistance, diet, glare, etc. People of poor physique and insufficient diet appear to be especially susceptible to various ocular diseases.

The eye complaints due directly to the malarial poisoning are the following: (1) Keratitis dendritica, a sequel to herpes of the cornea, is

⁹⁴ Boletin de la Sociedad de Oftal. de Buenos Aires, vol. iv, No. 4, Abstracted in Archives of Ophthalmology, vol. xlvii, p. 300.

⁹⁵ Ann. d'Ocul., 1918, clv, p. 236.

⁹⁶ American Journal of Ophthalmology, vol. i, p. 393.

⁹⁷ British Medical Journal, August 3, 1918, p. 110.

due to a direct action of the malarial poison on the ganglion trophic cells of the fifth nerve. Quinine will not help the condition unless given energetically at the very beginning of the attack. (2) A similar poisoning of nerve elements by the direct action of malaria results in external muscle paralysis. The third, fourth and sixth nerves may be affected, more commonly the sixth. (3) A malarial neuralgia affecting the ophthalmic division of the fifth is common and may produce reflex conjunctival inflammation, but a pure malarial conjunctivitis would be difficult to diagnose. Kirk has never seen a malarial iritis, cyclitis or choroiditis but admits the existence of a neuroretinitis as a complication in malignant and subtertian cases. A retrobulbar neuritis is occasionally met with. Retinal hemorrhages are rare and are a result of capillary thrombosis following parasitic emboli or as a sequel to definite blood changes of a pernicious nature coincident with great anemia. It is probable that the parasites have no direct power of producing inflammatory results in the eye structures but they have the power of affecting the nervous supply of the eye probably by direct degenerative action on the central nerve elements resulting in (1) trophic changes in the cornea producing a typical keratitis, (2) degenerative changes in the optic nerve causing a neuroretinitis, (3) paresis of the extrinsic muscles of the eye, (4) affection of the sensory nerves of supply.

CONJUNCTIVA.

Trachoma. True trachoma, strange to say, seems to be rare with the natives of Cuba, most cases of the genuine disease being seen in foreigners. There exists a pseudotrachoma which is very prevalent. A large number of these cases have been studied by Penichet.⁹⁸ The resemblance to true trachoma is often very marked but the disease is said to respond like magic to operative treatment. Caution should be exercised about diagnosing trachoma until the effects of treatment are studied.

The results of ten uncomplicated cases of trachoma treated with a vaccine are given by Penichet.⁹⁹ These were treated with seven conjunctival injections each, of a solution containing the trachoma material. In every instance there was complete failure. In other cases with ulcers and pannus, some improvement was noticed. The conclusion was reached that so far the vaccine treatment of trachoma is not productive of good results.

Use was made of *mucous membrane grafts in the treatment of pannus* by Denig.¹⁰⁰ These grafts were applied not for plastic operations but as a curative measure. One hundred and fifty cases were so treated, using almost exclusive mucous membrane of the mouth as a graft. It is necessary to isolate the trachoma of the cornea from its base, and this can only be done by covering the defect thus produced with a graft preferably of mucous membrane. A majority of pannus cases were cured by a single transplantation. The flaps are taken from

⁹⁸ Cronica Medico-Quirurgica, Havana, April, 1918, p. 211.

⁹⁹ Ibid., January, 1918.

¹⁰⁰ New York Medical Journal, June 8, 1918, p. 1074.

inside the mouth and must not be too thick. Usually a thin flap is absorbed in one or two years, the thicker ones in five. By this method dense trachomatous pannus has been cured in four to eight weeks.

Gonorrheal Ophthalmia. The use of parenteral protein and non-specific vaccine in the treatment of ophthalmic diseases has found enthusiastic advocates in v. Szily and Sternberg, who obtained remarkable results with a typhoid vaccine in gonorrheal ophthalmia. Good results have also been reported from the use of diphtheria antitoxin while De Lorme¹⁰¹ found the vaccine method of Nicolle and Blaizot productive of good. R. Müller used the parenteral injection of milk. Andersen¹⁰² reviewed this work and drew attention to the ill effects noted by Elschmig, who reported sloughing of the cornea and prolapse of iris following parenteral injections of milk for gonorrheal ophthalmia. It would seem necessary to furnish incontestable evidence that the parenteral injections were the cause of the corneal sloughing and not the disease itself. Reliable information regarding the role of ophthalmia neonatorum in causing blindness is furnished by the report of the National Committee for the Prevention of Blindness. It contains a table giving statistics of ophthalmia neonatorum during 1916-17, in thirty State Schools for the Blind in the U. S. Among the 2961 pupils in the thirty schools, 742, or 25 per cent., had been blinded by the disease; while as regards 558 new admissions, 109, or 19.5 per cent., had suffered in like manner.

Vernal Conjunctivitis. The number of remedies used in the treatment of vernal conjunctivitis speak for the inefficiency of all of them. Any remedy possessing a modicum of virtue is deserving of consideration. Radium is advocated, but its prohibitive cost must of necessity limit its use even though it be proved a specific. Shumway¹⁰³ had success with this remedy when all other measures failed. Other cases are cited in the literature, viz., those of Lawson, Shine and Butler. The remedy is of value in curing those cases of vernal catarrh of the palpebral type resistant to other treatment. The dosage used by Shumway is large, preferably 25 to 35 mg. for periods of fifteen minutes at intervals of two to four weeks. Pusey¹⁰⁴ holds the lid in a special clamp and applies a flat radium applicator to the everted lid. It is passed back and forth over the lid just short of contact with the surface. The applications are made in broken doses and are of five minutes' duration over the whole lid. This is done for six successive days. An interval of several months is then allowed. The results have been about the same as those with roentgen-ray treatment. Butler¹⁰⁵ looks upon radium as a specific in vernal catarrh and contends that the diagnosis, which is often questioned, can be made by the examination of the smear. Trachoma and phlyctenular conjunctivitis are the diseases likely to cause confusion.

Antiseptics in Eye Affections. In the search for an antiseptic not injurious to the conjunctival epithelium, yet effective against the

¹⁰¹ PROGRESSIVE MEDICINE, 1918, p. 345.

¹⁰² Hospitalstidende, February, 1918, p. 244.

¹⁰³ American Journal of Ophthalmology, June, 1918, p. 404.

¹⁰⁴ Journal of American Medical Association, vol. lxxi, p. 806.

¹⁰⁵ British Journal of Ophthalmology, vol. i, p. 411.

bacterial flora of the conjunctiva, A. S. and L. D. Green¹⁰⁶ hit upon dichloramin-T. solution. They found that a solution of from 0.5 to 1 per cent. can be freely used as a conjunctival antiseptic without injury to the tissues. Possibly stronger solutions may be used but they were not found necessary. The oil solution is preferable to the aqueous, as it is less irritating and remains longer in contact with the epithelium. Instillations as frequent as every hour are found most satisfactory. It might be well to give the remedy a trial in gonorrheal ophthalmia.

Chloramin has been used as a powerful disinfectant for corneal ulcers, etc., by De Lapersonne.¹⁰⁷ To be perfectly borne it should be applied as a 4 per cent. collyrium or in a 1 or 2 per cent. gelose cream.

Care of the Eyes during Etherization. The precautions usually taken to avoid postanesthetic conjunctivitis are stated by Miller¹⁰⁸ to really increase the danger and often are the sole cause of the trouble. A drop of ether in the eye causes no severe reaction but when the towel or gauze covering the eyes becomes saturated with ether and remains so a severe conjunctivitis will probably result. It follows, therefore, that during general anesthesia the eyes should not be covered. The lids should be kept closed and should any ether be accidentally dropped in the eyes they may be washed with saline solution. The lid reflex may be tested with the finger and the unclean and unnecessary habit of eliciting the corneal reflex with the finger should be abandoned.

Parinaud's Conjunctivitis. The clinical picture of Parinaud's conjunctivitis has for a long time suggested an infective organism as the cause of the disease. Verhoeff, in 1913, described a leptothrix as the causative agent. His findings, while not antagonized, were not generally accepted. The presence of the leptothrix is not easy of demonstration. The tubercle bacillus at one time was looked upon as the possible cause. In many cases inoculations of guinea-pigs and rabbits proved the absence of the tubercle bacillus. The successful transmission of the infection to white mice from pus derived from the pre-auricular gland of a case of Parinaud's conjunctivitis is particularly interesting. This important work was done by Wherry and Ray.¹⁰⁹ The pus was injected subcutaneously producing an infection in the mouse after an incubation of four or five days, characterized by purulent conjunctivitis and death. The leptothrix was isolated from muscular abscesses found at post-mortem which grew only on slants of egg yolk and incubated under partial tension and anærobic conditions. The pus injected into a second mouse reproduced the symptoms. A similar organism derived directly from the pre-auricular gland of the human case in its later stage was isolated on egg yolk. Further evidence in regard to the leptothrix was furnished by Verhoeff.¹¹⁰ In 18 cases the leptothrix was found and verified by full microscopic examinations. Verhoeff proposes to drop the name Parinaud's Conjunctivitis and substitute Leptothricosis conjunctivitis.

¹⁰⁶ Journal of American Medical Association, vol. lxx, p. 1212.

¹⁰⁷ Presse Médicale, January, 1918, p. 53.

¹⁰⁸ Journal of American Medical Association, vol. lxx, p. 83.

¹⁰⁹ Journal of Infectious Diseases, June, 1918, p. 554.

¹¹⁰ American Journal of Ophthalmology, 1918, vol. i, p. 705.

Phlyctenular Conjunctivitis. ETIOLOGY. Numerous theories have been submitted in explanation of the etiology of phlyctenular disease but none have proven satisfactory. Goldenberg looked upon intestinal putrefaction resulting from ingestion of too great quantities of carbohydrates as the cause. The theory met with criticism and was not supported by the experience of others. Turner¹¹¹ was of the opinion that trouble in the ethmoid sinuses accounted for the outbreaks of the phlyctenules. Gibson¹¹² falls back upon the older theory of tuberculosis. His opinion was based on clinical observations in 92 cases, of which 90 gave a positive von Pirquet test. This in itself is not convincing. Stronger evidence was furnished by the experimental production of phlyctenules in tuberculous rabbits in eight instances. Attempts to produce the condition in non-tuberculous animals were unsuccessful. Microscopic examinations showed a similarity between the experimental and human phlyctenules, and the findings suggested a tuberculous origin. From the evidence at hand, clinical, pathological and experimental, tuberculosis and tuberculosis alone is looked upon as the cause of phlyctenular disease.

CORNEA, LENS AND SCLERA.

Grafts of the Cornea. Little success has followed attempts at corneal grafts. With the exception of the epithelial coat they lose their physiological personality. In his experimental work, Bonnefon¹¹³ demonstrated that experimental grafts are successful because they are regenerated from the surrounding transparent cornea. Clinical grafts, on the other hand, are made not on sound cornea but on degenerated cicatricial tissue, and therefore active regeneration cannot be depended upon.

Swallowing Reflex of the Cornea. Many, no doubt, are familiar with the swallowing reflex when a bland solution is instilled on to the cornea. This reflex is said to be quite constant (85 per cent. of 500 cases) by Strebel.¹¹⁴ Its absence is of diagnostic import and indicates lessened sensibility of the cornea, and is therefore to be looked for in such conditions as herpes of the cornea, neuropathic keratitis and even in glaucoma.

Trypanosome Keratitis. The lesions in trypanosome keratitis are said to be identical in man and the dog. In man, however, they are milder and no hemorrhage occurs in the anterior chamber. The keratitis and iritis are not severe, and in some cases there is but slight ciliary injection. Daniels¹¹⁵ saw six cases in England. The time of onset is indefinite. The eye lesions are looked upon as a toxic phenomenon and bear no relation to the parasites in the blood or the severity of the symptoms. In the human cases recovery rapidly follows treatment by arsenic in all but Rhodesian cases, which are fatal. Woods and de Schweinitz,¹¹⁶ from their

¹¹¹ Pre Sessional No. Trans. Sec. Ophthal. A. M. A., 1918, p. 157.

¹¹² American Journal of Diseases of Children, February, 1918, p. 81.

¹¹³ Lyon Chirurg., vol. xiv, p. 903.

¹¹⁴ Correspondenz-Blatt f. Schweizer Aerzte, September, 1918, p. 1311.

¹¹⁵ British Journal of Ophthalmology, ii, 83.

¹¹⁶ Archives of Ophthalmology, xlv, 431.

experiments on trypanosome keratitis in dogs, found a marked resemblance to the keratitis in man produced by the *Treponema pallida*.

Blue Sclerotics. The association of blue sclerotics and osteoporosis has been observed many times. Van der Hoeve and de Kleijn were the first to note the further fact that otosclerosis belongs to the symptom complex. After reading Bronson's¹¹⁷ article on the same subject, Conlon¹¹⁸ was moved to restudy his cases which had been reported in 1913 and in which otosclerosis had not been noted. He found the father of the present generation has otosclerosis, and that all his family who had blue sclerotics were also deaf and those who had normal colored sclera had normal hearing. The conclusion seems justifiable that the deafness in these cases was the result of otosclerosis.

Another feature noted by Marconi¹¹⁹ was visible hypotrophy of the circulatory apparatus. To explain the three findings of blue sclerotics, osteoporosis and hypotrophy, a theory of arrested development of the mesenchyma from inherited or acquired causes was invoked.

Cataract. Various measures have been devised to influence the course of a cataract (immature), but none of these has met with much success. All ripening operations are fraught with danger on account of retained cortex after extraction and prolonged iridocyclitis. Homer Smith offered a preliminary capsulotomy eight hours preceding extraction. Col. Smith, of India, meets the situation by extracting the lens in its capsule even if the cataract is immature. Scalinci¹²⁰ makes multiple punctures of the equatorial portion of the lens, repeated in a week. A month later the cataract is extracted. The procedure is recommended for the dyscrasic type of senile cataract. In criticism of this method it might be said that repeated punctures subject the eye to repeated trauma and danger of infection, and that what is accomplished in a month may be brought about with no greater trauma or danger and more effectively in twenty-four hours by the Homer Smith method.

Of non-surgical methods, radium has been tried experimentally by Levin and Cohen¹²¹ for the treatment of cataract. Their cases were not promising, two of the three being secondary, and the results not striking. Some improvement in vision and decrease of the lenticular opacity were noted. The authors well state that it is premature to say whether the action of radium on cataract will have a permanent or any therapeutic value.

To say that everyone would develop a cataract if one lived long enough, but that everyone would likewise obtain a spontaneous cure if life were sufficiently prolonged, seems like a radical statement by Gifford.¹²² The occurrence of spontaneous absorption is not so rare as is generally supposed. Visual results, however, are not good, and the frequency with which glaucoma is associated with the absorption of senile cataract has been noted by a number of observers. Most

¹¹⁷ Edinburgh Medical Journal, April 1917.

¹¹⁸ American Journal of Ophthalmology, 1918, p. 726.

¹¹⁹ Gazzetta degli Ospedali e delle Cliniche, Milan, May, 1918, p. 367.

¹²⁰ Riforma Medica, Naples, July, 1918, xxxiv, 529.

¹²¹ New York Medical Journal, July 6, 1918, p. 4.

¹²² American Journal of Ophthalmology, February, 1918, p. 83.

authors consider the absorption is the result of glaucoma or some other inflammatory condition. Gifford takes the reverse position and thinks the spontaneous absorption of the cortex of a senile cataract produces in many cases an increase of tension, which may be temporary and unnoticed or which may lead to complete blindness. The lesson to be derived from this is that a senile cataract should be kept under observation and operated upon before it becomes too hypermature, even if the other eye still has good vision.

Injury to Eyes from Lightning Stroke. Injuries to the eyes following lightning stroke usually involve the lens. Young individuals, strangely, seem to be the chief sufferers. The lens changes have been attributed to direct physicochemical action of the electricity. Some hold that the lens haze is due to a rupture of the capsule while others think there is a direct burn of the lens as a result of the high temperature. Posey¹²³ reported two instances of eye injury from lightning stroke, and agrees with Hess's theory of lens changes in this class of cases. According to Hess, the opacities of the lens and atrophy of the optic nerves are produced not like the external injuries by the action of heat but by the power possessed by electric discharges to kill living cells, even without the development of heat.

VITREOUS.

Intra-ocular Foreign Bodies. The search for intra-ocular foreign bodies is not always crowned with success. At times the magnet fails for various reasons, and at other times the *x*-ray pictures do not reveal one. Valude¹²⁴ emphasizes the fact that a good radiograph in general surgery may leave unnoticed a minute foreign body which would be discovered by the radiographic methods of an ophthalmological clinic. De Lapersonne urges that foreign bodies should be removed at once, but recognizes the fact that radioscopy often fails to show small fragments, so that a number of negatives may be necessary, as exact localization is essential. Because of the nature of modern warfare, wounds of the eye are exceedingly frequent. Many are due to penetrations of small metallic fragments. De Lapersonne¹²⁵ noted 193 in 1000 eye cases. The fragments consisted of pieces of shells or grenades, bits of nickel, copper, glass, wood and stone. The immediate result was usually a plastic iridocyclitis. A late complication is siderosis in the case of iron. This sets up a chronic iridocyclitis which results in a softening and atrophy of the globe. Fluoroscopy has proved a failure so that reliance should be placed on exact *x*-ray localization. Having localized a magnetizable foreign body, the method of extraction must be decided upon. Some prefer to remove the body through the original point of entry, using a giant magnet. Others extract all posterior foreign bodies through a clean scleral incision. Allport¹²⁶ condemns the use of the giant magnet for *all* cases with the withdrawal of the fragment through

¹²³ American Journal of Ophthalmology, 1918, p. 88.

¹²⁴ Ann. d'Ocul., 1918, clv, 261.

¹²⁵ Bulletin de l'Académie de Médecine, February 1912, 18, p. 134.

¹²⁶ American Journal of Ophthalmology, June, 1918, p. 412.

the original wound. In many cases it is safer, wiser and better to extract posterior fragments through a scleral incision. The scleral incision should not be sutured. It suffices to cover the wound with a conjunctival flap. It is best not to introduce magnet points inside the eyeball.

There may be more than one fragment within the eyeball and the egregious error of overlooking the second should not be committed. A trial pull to ascertain the existence of a foreign body is bad practice. The sooner foreign bodies are removed the better, and one should not place too much reliance on the possibility of the fragment being aseptic. Pooley, of England, discourages attempts at removal of fragments embedded in the choroid. This advice Allport holds to be wrong. In the handling of intra-ocular foreign body cases the following rules are advocated: (1) In the recent injury where wound healing has not yet occurred the steel should be removed through the original opening whether this is in the cornea or sclera. (2) When the wound has healed and the steel is in the lens or anterior to the lens it should be removed through the cornea. (3) Where the wound has healed and the steel is in the vitreous chamber, it should be removed through the sclera.

Effects of Gassing on the Eyes. Previous mention has been made by Derby¹²⁷ of the effects of gas on the eyes. In a later study¹²⁸ the action of mustard gas (dichlorethylsulphide) was noted. Eighty per cent. of the gassed soldiers show eye lesions of varying severity which are of the nature of a chemical burn. The lids are reddened, swollen and often show numerous large bullæ. Irritation and photophobia are intense. Chemosis is marked in severe cases. Ciliary injection is frequent. The cornea is involved in severe cases varying from a slight roughening of the epithelium to a well-defined opacity, usually in the form of a band extending across the cornea, opposite the palpebral fissure. Rarely the band is of porcelain whiteness. In the absence of ulceration the corneal lesions heal rapidly and without a trace. The photophobia is explained by the corneal involvement.

As regards prognosis the cases are divided into three classes by Cerise:¹²⁹ (1) Benign, 10 to 15 per cent., duration ten to fifteen days; (2) medium, 80 per cent., duration five to six weeks; (3) severe, 3 to 5 per cent., seen in those with marked general symptoms who often develop a bronchopneumonia. Photophobia and blepharospasm of a functional nature may occur in exposed persons with an unstable nervous system. The tendency is to spontaneous cure, though proper treatment hastens it. Secondary optic atrophy the result of gassing has been reported by Kershner.¹³⁰ A review of the literature on the subject of the ocular effects of mustard gas, with experimental, clinical and microscopic findings, has been furnished by Warthin, Weller and Hermann.¹³¹

In a description of the effects of gas (Sulfure d'ethyle bichlore)

¹²⁷ PROGRESSIVE MEDICINE, 1918.

¹²⁸ American Journal of the Medical Sciences, November, 1918, clvi, 733.

¹²⁹ Ann. d'Ocul., 1918, clv, 240.

¹³⁰ American Journal of Ophthalmology, 1918, p. 168.

¹³¹ Journal of Laboratory and Clinical Medicine, No. 1, iv, 785.

recently used by the Germans, Teulieres¹³² found 23 severe eye lesions in 1500 gassed men. These included 3 cases of ulceration of the cornea and 1 panophthalmitis. Some of the cases were obstinate. In one instance the conjunctivitis, photophobia and lacrimation persisted for five months, and the conjunctiva had the appearance of porcelain.

Glaucoma. The combination of glaucoma and cataract is an unwelcome one for an operator. One of the ever-present dangers is hemorrhage, with usually the loss of all vision. The retention of useful sight in such instances is rare. Maynard¹³³ cited an instance in which useful vision was retained after a severe hemorrhage following operation for glaucomatous cataract. Final vision = one-fifth plus.

Operation in congestive glaucoma is sometimes followed by an aggravation of the symptoms, constituting malignant glaucoma. With this there is a return of tension and rapid loss of sight. Return of tension in chronic glaucoma is usually due to the closing of the operative wound by uveal tissue or prolapse of the vitreous. Knapp¹³⁴ recorded a case of detachment and dragging of the retina into the trephine opening presumably due to retrochoroidal hemorrhage following a trephining for glaucoma. As the hemorrhage followed vomiting on recovering from ether the case illustrates the dangers of general anesthesia in glaucoma operations, particularly trephining and sclerotomy. Morax¹³⁵ has observed 5 cases in war wounded secondary to intra-ocular foreign bodies. In 2 the eye has been struck by a magnetic splinter extracted after three or four months. In 1 case it contained a fragment of stone. In the 2 others, with traumatic cataract, the presence of a foreign body could be suspected, but radioscopy did not reveal it and radiography was not made. The glaucomas had happened unexpectedly in the absence of all signs of iridocyclitis or lesions of the lens (swelling or luxation) capable of provoking it. Two had been treated by miotics, 2 by iridectomy and 1 by trephining. Results had been bad in all.

Local Anesthesia for Operations on Eyes. It is well known that it is difficult to bring about satisfactory local anesthesia in inflamed tissues. In ophthalmic work it is necessary at times to operate on eyes which are exquisitely tender, as, for instance, acute congestive glaucoma and secondary glaucoma the result of a traumatic cataract. The giving of a general anesthetic is often necessary, but because of postoperative vomiting it is not desirable. In such cases satisfactory and complete anesthesia is obtained by Haab¹³⁶ by the subconjunctival injection of 10 per cent. cocaine solution (2 drops) at the site of the proposed iridectomy. The same method is applicable in operations for the removal of intra-ocular foreign bodies. Anesthesia is complete in from seven to ten minutes following the subconjunctival injection.

The Tear Sign of Actual Death. Numerous tests are used to detect the presence of actual death in the supposed dead. A number of these

¹³² Jour. de méd. de Bordeaux, February, 1918, p. 37.

¹³³ British Journal of Ophthalmology, January, 1918, p. 26.

¹³⁴ Archives of Ophthalmology, May, 1918, p. 256.

¹³⁵ Annales d'Ocul., clv, 11.

¹³⁶ Correspondenz-Blatt f. Schweizer Aerzte, xlviii, 593.

relate to the eyes. Quite recently the instillation of dionin in the conjunctival sac was recommended as a reliable test. In the living a marked reaction, with chemosis, occurs, while in the dead this does not occur. Another test which has to do with the reaction of the tears to litmus is recommended by De Toledo.¹³⁷ In the living the reaction is alkaline, which changes to acid after death. This occurs in from half an hour to seven and a half hours. Cold weather slows the change. The reaction was never found to be acid in the living. Acidity of the tears after death is not a constant finding, but, when present, it is reliable. Reference is made to the tear test for death from another quarter. Lecha-Marzo¹³⁸ also finds an acidity of the tears after death, and asserts that it is constantly reliable. In the living the reaction was always found alkaline in 542 men and 537 women, and likewise in 1104 hospital cases some of which were suffering with such eye conditions as blepharitis, lacrimal fistulæ and iritis. To apply the test a piece of litmus paper is inserted between the eyelids on to the globe and the lids pressed upon it. In the living the paper shows a blue spot and in the dead no change occurs or else it becomes more pink.

Careless Methods in Fitting Artificial Eyes. Attention has been called on various occasions to the unsanitary method of fitting artificial eyes. It is only too true that this procedure has been done in a more or less slipshod manner. To return an artificial eye to the case without cleansing it, after having tried it in a socket, is not only unsanitary but filthy. Just how much of a factor it might be in spreading disease is unknown. Lewis¹³⁹ mentions a case of acute purulent conjunctivitis due to such carelessness. Mention is made of the fact that many eyes are removed in syphilitic and other diseased individuals, which makes the careless and dirty fitting of artificial eyes the more reprehensible.

¹³⁷ *Cronica Medica*, Lima, January, 1918, p. 20.

¹³⁸ *Archives Médicales Belges*, lxxi, 271.

¹³⁹ *Journal of the American Medical Association*, 1918, lxx, 1882.

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